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PIPE LINE INDUSTRY

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BETTER DESIGN
New Gas Flow Calculation Manual Coming 26

FOR PIPELINERS
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PIPE LINE INDUSTRY

A GULF PUBLISHING COMPANY PUBLICATION

July 1960 Vol. 13, No. 1

CONTENTS and Quick Look

To help you put first things first, scan these time-saving digests, checking ☑ those you want to read first.

Pipe Lines and Politics

☐ For a penetrating look at politics 1960, see the editorial on Page 4 and the comprehensive report starting on **Page 32.** This report shows the voting records of potential presidential and vice presidential candidates on major oil and gas issues—plus an inside look at voting records of the 30 senators seeking reelection.

Flow Calculation Manual for Natural Gas Transmission Lines Is Under Development

☐ This is just about ready for release in manual form. Here are the equations which will be used in future design and flow equations. More work has been done on the roughness factor and the equation is now in usable form.

By R. T. Ellington and W. R. Staats.....Page 26

Synthetic Lube Reduces Fire Hazard at Turbine Stations

☐ This is Part 2 of Texas Eastern's comprehensive study of the new fire-resistant lubes for gas-fired turbines. Actual conversion of a station to the synthetic system is described.

By O. M. Fletcher.....Page 39

Thirty-Inch Line Pulled 14 Miles Under Caribbean

☐ From the Isle of Margarita to the Venezuelan mainland, the pipe was coated internally and externally with concrete and pulled along the bottom in 2,400-foot hitches by winch barge which snubbed off to two anchor cables laid along the route.....Page 44

Humble's Multichannel Radio Alarm and Control System

☐ New economy so far as high speed remote controls are concerned. The system uses a narrow band of the spectrum, and each station costs only $2,500, not including the cost of the tower. Offshore unit at Grand Isle, La., is battery-powered. Battery life is estimated at 3 to 5 years. Another interesting feature: the system uses the newly available industrial development frequencies in the VHF band.

By G. G. Van Burkleo and L. A. M. Barnette.....Page 46

The Two Processes of "Memory"

☐ Recall and recognition are the two ways that you remember previously learned material. The conclusion of this two-part article tells you why you sometimes forget.

By John D. Quinton.....Page 50

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Practical Political Advice From a Man Who Knows

These remarks from an address by Allan Shivers, chairman of the board of Western Pipe Line, Inc., and former governor of Texas, presented at the recent API Pipe Line Conference give good reasons for being politically informed and active in this election year. Regardless of your political party or philosophy, PIPE LINE INDUSTRY believes you will find his advice worth keeping in mind, especially in the next few months.

"THE PIPE LINE INDUSTRY has no choice when it comes to 'staying out' or 'getting into' politics. We are already in politics, whether we want to be or not.

"Politics, translated into government action, is the strongest single determining factor in American business today. This is a fact to be recognized, if not cheerfully accepted. It shows up in vastly increased governmental control and regulation of business, so it is the merest gesture of self-protection for a businessman or an industry to 'get into politics.'

"What does this mean? Let us consider first some things that it does not, or should not, mean.

"Effective participation in politics does not mean merely the pursuit of specific selfish goals. Participation must be upon a broader basis, with due deference to the public interest; else the individual or the segment of the isolated industry will be chopped to pieces.

"Effective political participation does not mean concerning oneself only with 'important' offices, such as Governor and President. Laws are made and taxes are levied at the legislative level, whether in Washington, the state capitol, the county courthouse or the city hall. Presidential drives are launched and party platforms started at the precinct convention. Politics, in a literal sense, begins at home.

"Being 'effective' does not, or should not, call for undue personal influence with politicians and officeholders. This is not to say that undue influence is not exerted in government, sometimes successfully. It is well for businessmen to remember, however, that there is a double standard for business and politics. Practices considered acceptable in business can become scandalous in politics. Presents, trips, favors for friends—these are commonplace things in business relations. In government, they can ruin careers and lose elections. If one's moral sense is not strong enough to avert this danger, perhaps common sense will do the job.

"Effective political action is not 'independent' or 'non-partisan' action. Non-partisan politics is non-effective politics. You can learn the ground rules that way, but the game has to be played head-on. A brief formula for practical participation in politics might be:

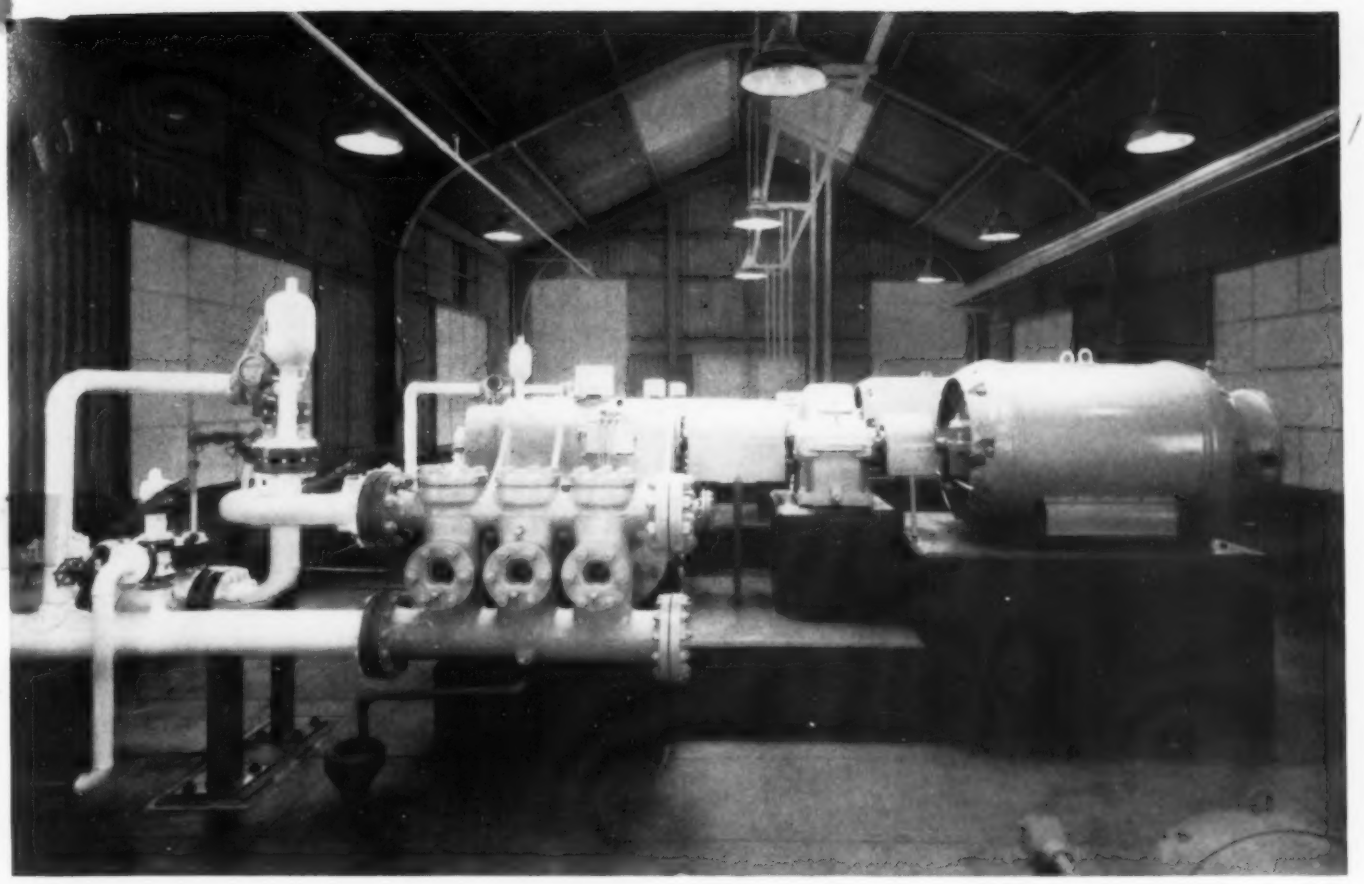
- Find your cause
- Find your leader
- Find some friends.

"Effective politics has to be something more than a negative holding action. You have to be for something and for somebody. In Texas politics we say: 'You can't beat somethin' with nothin'."

"Effective political participation is not an all-or-nothing matter. It might be described as making the best of what you have. In politics, as in the rest of life, our choice is not always clearcut between good and bad. It is the choice of the greater good, or more often, the lesser evil. This does not mean compromising on principles; it often does mean compromising on men, methods and short-range goals.

"The non-effectiveness of pure self-interest does not mean, of course, that self-interest should or could be eliminated. It is one of the mainsprings of political action. The petroleum industry, for example, should fight on united for percentage depletion, for sensible amendments to the Natural Gas Act, for a fair and workable policy on imports, against a national fuel policy that is only 'end-use control' in disguise, and against inequitable taxation.

"Interest should not end there, however, but go on to encompass the greater goal without which no industry can long prosper, and that is the preservation of our free enterprise system."



They're pumping products to market with these "Oilwell" Triplex Plunger Pumps

IN THIS PUMPING STATION, three "Oilwell" Triplex 358-P Plunger Pumps take care of the round-the-clock assignment of moving LPG from the field processing plant in New Mexico to marketing terminals in Utah.

Their horizontal design with (1) large power-end access covers, (2) outside access for bearing adjustments, (3) crosshead shoes, (4) two-piece plungers, (5) removable stuffing boxes, (6) screw-type glands, (7) interchangeable individually removable valves and (8) individual cylinder heads and valve covers; requires minimum attention and simplifies maintenance.

The 358-P fluid end accommodates a variety of plunger sizes and provides pressure-capacity selections covering a wide range of pumping requirements. The 368-P fluid end, which is fully interchangeable, extends capacities at reduced pressures.

USS and "Oilwell" are registered trademarks

Bring your pumping problems to "Oilwell" and let experienced sales engineers recommend the type and size pump to meet your exact requirements.

PERFORMANCE DATA

Plunger Size, Inches	Maximum Working Pressure (psi)	Normal Displacement Range Barrels per 24 hours at pump speeds (rpm) of:				
		100	125	150	175	200
358-P						
3¼	2,410	2,950	3,680	4,430	5,160	5,890
3½	2,080	3,430	4,290	5,145	6,000	6,850
4	1,590	4,460	5,550	6,680	7,800	8,900
4¼	1,260	5,655	7,060	8,460	9,900	11,300
5	1,020	7,000	8,740	10,500	12,230	13,970
368-P						
5½	840	8,435	10,540	12,650	14,750	16,840
6	710	10,075	12,590	15,100	17,630	20,600
6½	600	11,825	14,800	17,750	20,700	23,600
Brake Horsepower Required		133	166	200	232	266

Oil Well Supply Division of USS United States Steel

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Drills sixteen 55 ft. holes in 8 HOURS on freeway

16" dia. Ka-Mo drill swung from boom of truck crane prebores for pilings on Houston Freeway extension in Orange County, California.

Ka-Mo 16" drill sets record pace preboring for pilings on Houston Freeway

Bertran Drilling Co., contracted to prebore holes for cast-in-drilled hole concrete pilings on construction of Houston Freeway extension in Orange County, Calif. Job called for drilling a series of vertical and battered holes — 16" in dia. — with various depths to 72 ft. To handle work, Bertran brought in a Ka-Mo vertical drill, powered by a 34 h.p. self-contained hydraulic motor. Swung from boom of 25-ton truck crane, the 16" dia. drill bored as many as 16 holes — 55' deep — in 8 hours! At several places on job — same drill also bored eight 72-ft. holes in one 8 hr. shift. Record production — 2 to 1 over any other machine owner is familiar with — was obtained by using continuous sectionalized drill flights.

10 to 15% saving in concrete

Vic Zonver, owner of Bertran Drilling reported an unexpected saving in amount of concrete used to pour pilings bored by Ka-Mo drill. Normally, by preboring with conventional systems, hole needs 10 to 15% more concrete than estimated theoretical volume. Drilled holes by Ka-Mo continuous-auger system required only about 1% more concrete.

Pays to check

Whether your work involves angular, vertical, or horizontal drilling, it will pay you to check the Ka-Mo line. Drill sizes 2" to 48" diameter, and larger — sectionalized lengths — air, hydraulic, electric, gasoline, or diesel powered. Engineering service is always available for these special installations. Just write or call.

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PIPE LINE INDUSTRY and The PIPE LINE CATALOG for the oil and gas pipe line industry.

WORLD OIL (formerly the Oil Weekly) and The COMPOSITE CATALOG for the drilling-producing industry.

PETROLEUM REFINER and The REFINERY CATALOG for the oil, gas and petrochemical processing industry.

Indexed by Engineering Index

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NEAR PERRIN, TEXAS

D6B MOVES EARTH FASTER—preferred by oil company

Owner Willie M. Mitchell keeps his D6B busy the year around. In addition to oil field jobs, he handles soil conservation work. A long-time user of Cat equipment, he says the new D6 is tops whatever the task.

"It's the best!" That's how owner Willie M. Mitchell described his new Cat D6B Tractor at a site preparation job 5 miles east of Perrin, Texas. "I'm moving dirt faster and easier than with my previous D6 and maintenance time is cut in half—the oil company I do work for wants Cat equipment on the job. They know they are getting more work for the hours they pay for."

Working in clay and packed drilling mud in wet weather, Mr. Mitchell dozes about 100 yards an hour in 150-foot passes. In a 10-hour day, he dozes or moves about 1000 yards. He finds the D6B with an 8-foot blade ideal for this kind of work. The short straight blade combines productive capacity with narrow width. No highway permits are required to move the machine from job to job.

Willie M. Mitchell has been operating tractors for the past 15 years and he knows what he is talking about when he states that the D6 "maneuvers well, has plenty of power, and visibility is good."

Your Caterpillar Dealer can prove to you right on your job how the new D6 steps up production. Call him today.

Caterpillar Tractor Co., General Offices, Peoria, Ill., U.S.A.

THE NEW D6 SERIES B

New Engine — The Caterpillar D333 Diesel Engine delivers 93 HP at the flywheel for an increase of 25 per cent in lugging ability. It features a new direct acting governor which means fast engine response to load changes.

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New Operator Convenience — All new cockpit has co-ordinated controls that make operation nearly effortless.

PLUS Timesaving Maintenance Features — The exclusive oil clutch gives up to 2000 hours of adjustment-free service. Lifetime lubricated track rollers with exclusive floating ring seals never need servicing during life of roller. Dry-type air cleaner removes 99.8% of the dirt even in the dustiest conditions, is serviced in just 5 minutes. Hydraulic track adjusters (optional).

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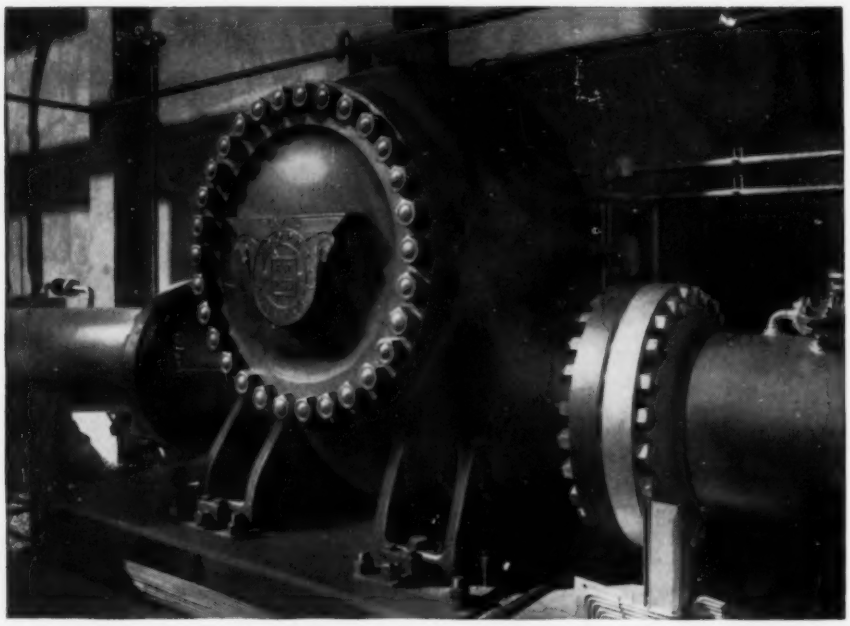
THE NEW D6— PERFORMANCE PROVED ON THE HARD JOBS



Cooper-Bessemer RFB-24 centrifugals, like this one, powered by Cooper-Bessemer LSV turbocharged gas engines, comprise the world's most efficient pipeline compressor units.

David M. Salls, *Manager, Gas Industry Sales, The Cooper-Bessemer Corporation, explains...*

How 5 Cooper-Bessemer powered, Gulf Interstate engineered stations will give Transwestern peak economy and flexibility

ALL FIVE of the mainline compressor stations of the new Transwestern Pipeline system will be equipped with Cooper-Bessemer engine-driven centrifugal compressors and will be remotely operated. These new automatic, remote-controlled stations will provide unexcelled efficiency and flexibility... a fact proven by the highly successful performance record of this modern equipment in other mainline stations of the same basic design—over 130,000 horsepower to date in mainline service.

The giant Cooper-Bessemer LSV-16 turbocharged gas engines will be of the type shown here. They will drive Cooper-Bessemer RFB-24 centrifugal boosters through speed increasers. Each of the five stations will include two of these high-efficiency compressor units. These units have the highest thermal efficiency obtainable in the gas industry today. The map shows the location of the stations. All units will be automatically controlled from a central point.

We will gladly supply details on this Cooper-

Map shows location of Transwestern's mainline automatic, remote-controlled stations. Background shows type of Cooper-Bessemer LSV-16 turbocharged engines to be used on this new line.

Bessemer equipment, and assist in *your* compressor station plans.

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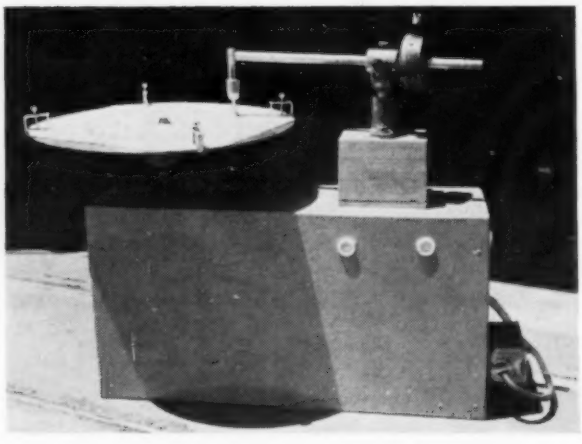

Scuff and abrasion test, as above, is only one of the many tests continually being conducted on Nicolet Pipe Line Products.

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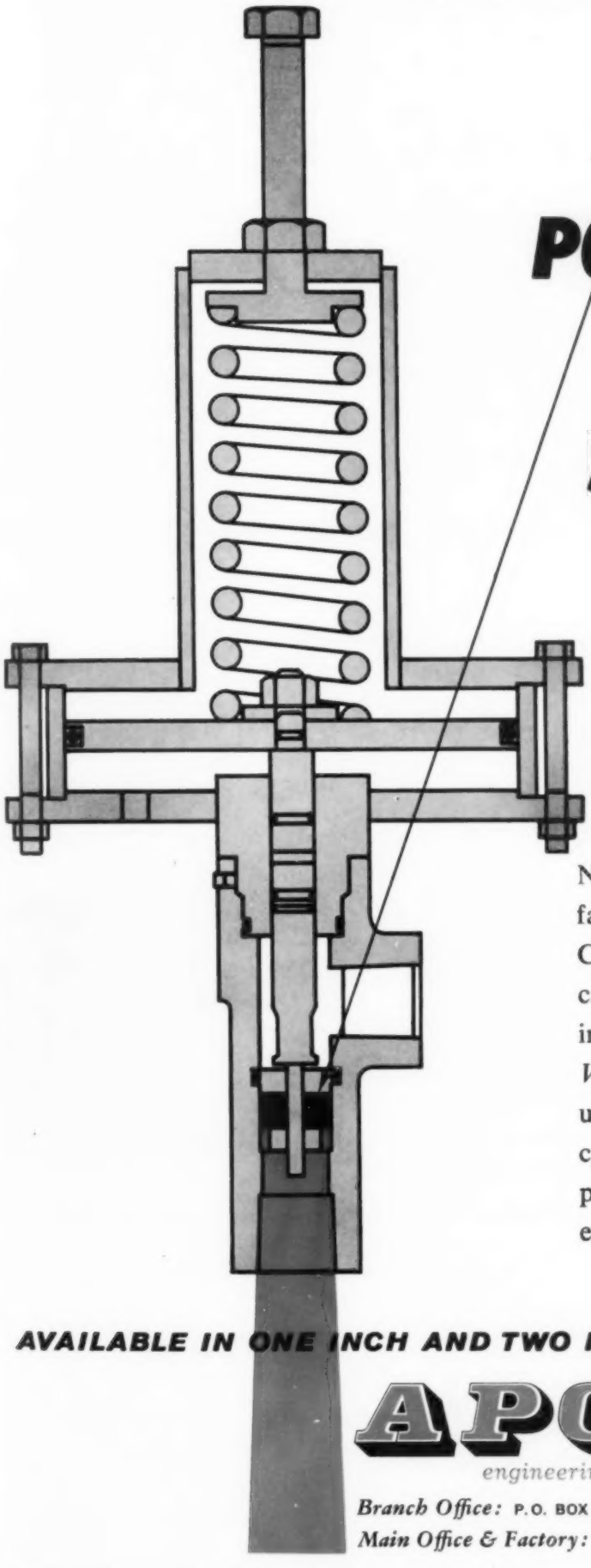

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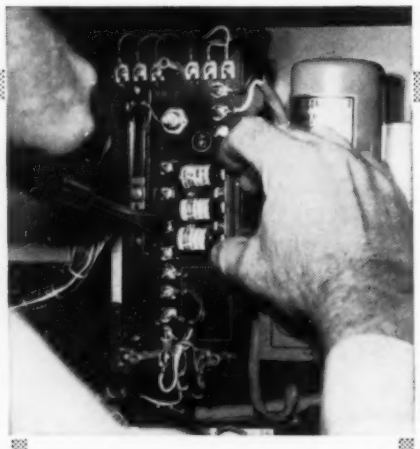
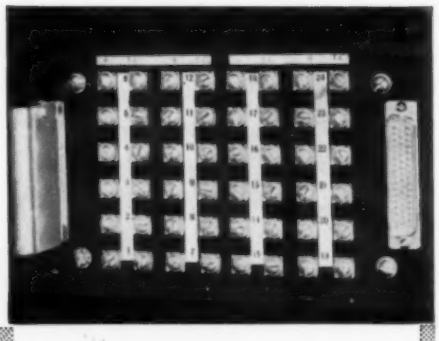
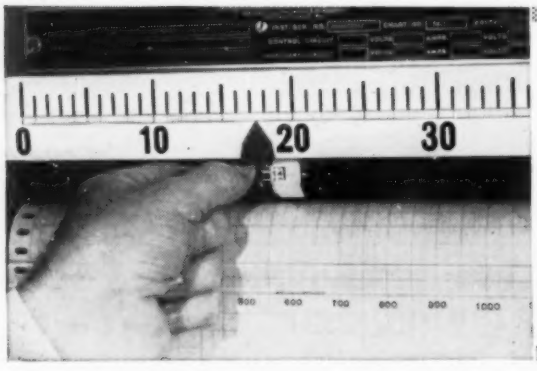


New modular design . . . and greater value than ever

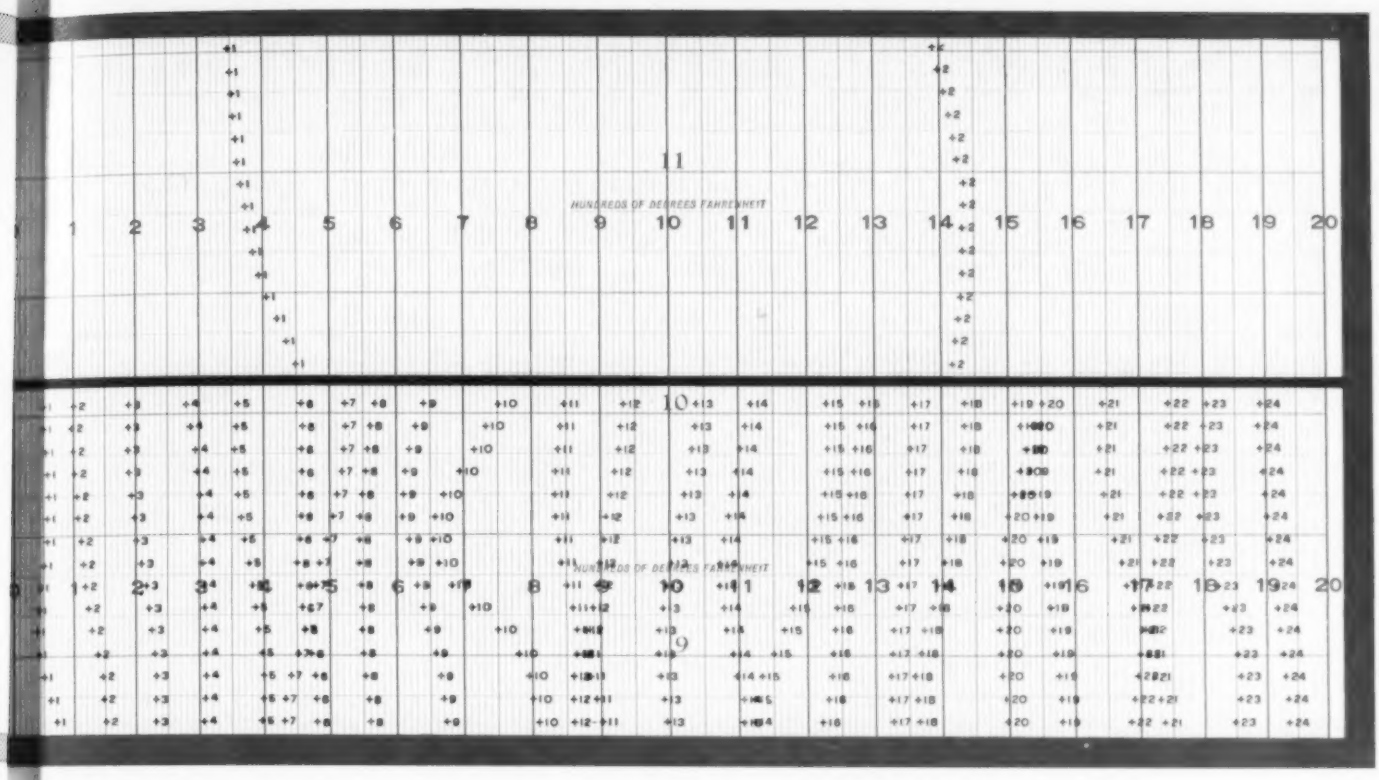
CHANGING RANGE IS EASY—Loosen screws and slide out the range resistor card. Replace with a different card, tighten screws and the job is done quickly and easily.





CHANGING NUMBER OF POINTS IS EASY—First, remove thumb-tight nut; slip off print wheel and indicator dial. Slip on new wheel and dial and replace nut. Second, replace one plug-in unit on extreme right of terminal board, and the instrument is ready to record any desired number of points.

CHANGING COMPENSATION IS EASY—Input terminal board comes out by removing one plug (extreme left) and four screws. Slide in the new board, replace the screws and plug and the compensation is changed. Reference junction is built into terminal board on reverse side.



Now, you can record 2,3,4,6,8,10,12,16,20 or 24 points on one instrument—the new Universal *ElectroniK* Recorder. And you can change the number of points to be recorded in a matter of seconds. It's as easy as this: remove a thumb-tight nut and slip off the old print wheel and indicator dial. Slip on a new wheel and dial and replace the nut. Plug in the number of points wanted, and the job is done.

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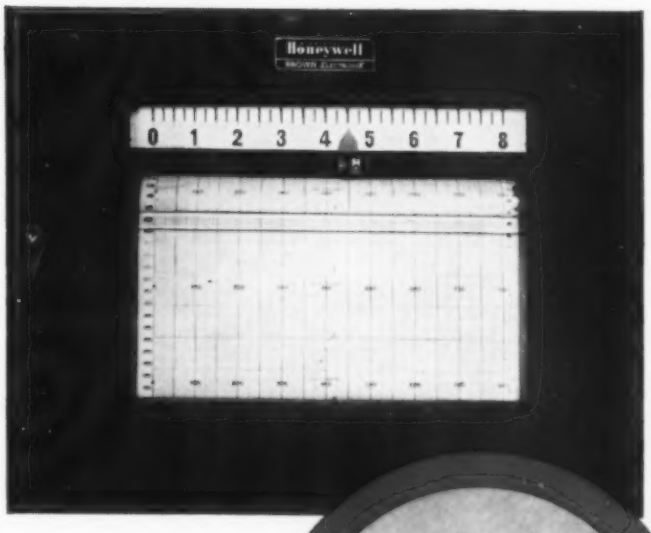

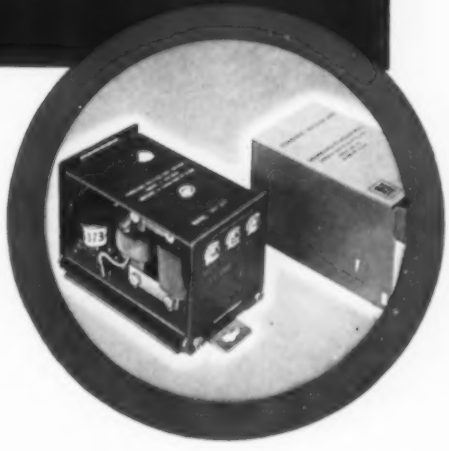

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Parts you can trust
... cost less per hour

Converting to Lifetime Lubricated Track Rollers costs less than you think

Lifetime Lubricated Roller Groups, including seals, shafts and end collars, *cost only a little more* than ordinary Bellows Seal Rollers without end collars. But this small expense of *initial* installation rapidly disappears through noticeably lower owning and operating costs.

Based on savings from seal replacement alone, Lifetime Lubricated Rollers soon make up the difference. The metal rings of the Floating Ring Seal can be used over and over again. Take a 14-roller D8. At every roller rebuild, you probably have to buy 28 bellows seals @ $3.97* each or a total of $111.16. Compare this with the rubber "O" rings costing a total of only $45.08*. You save $66.08 in seal replacement costs every time you rebuild or replace. Similar savings are available on all models. And, replacement Lifetime Lubricated Roller and shaft assemblies without end collars are priced below those of Cat Bellows Seal Rollers.

But your savings don't end here! Here are other benefits you get from Lifetime Lubricated Track Rollers:

1. Longer Lived Roller Shells and Component Parts. The Lifetime Lubricated Roller is much stronger and has more metal in the wear zones, specially hardened for extra resistance to wear. And bushings, bearings and shafts are larger and stronger and will last longer. These components are *always* bathed in *clean*, heat-dissipating oil (not grease). Dirt just can't get in to accelerate wear—oil can't get out, thanks to the patented Floating Ring Seal. This means you won't be buying as many replacement bushings and shafts at rebuild or roller replacement time.

2. Maintenance Is Eliminated. Lifetime Lubricated Rollers need no servicing until they're finally rebuilt. You don't have to spend any time nor money for lubrication during the rollers' lives.

3. Easier Installation. Snap-on rings hold seals and end collars in place *before* mounting. End collar bolt holes line up easily with track roller frame holes at installation. Your tractors will be on the go much sooner.

See your Caterpillar Dealer. He'll give you the complete facts on the economy of investing in Lifetime Lubricated Rollers . . . for *all* Caterpillar track-type equipment.

Caterpillar Tractor Co., General Offices, Peoria, Illinois, U. S. A.

*Suggested consumer prices for these Caterpillar parts

SERVICE TIP: Lifetime Lubricated Rollers need no servicing. But when rebuild time finally comes, keep metal rings matched in original pairs.

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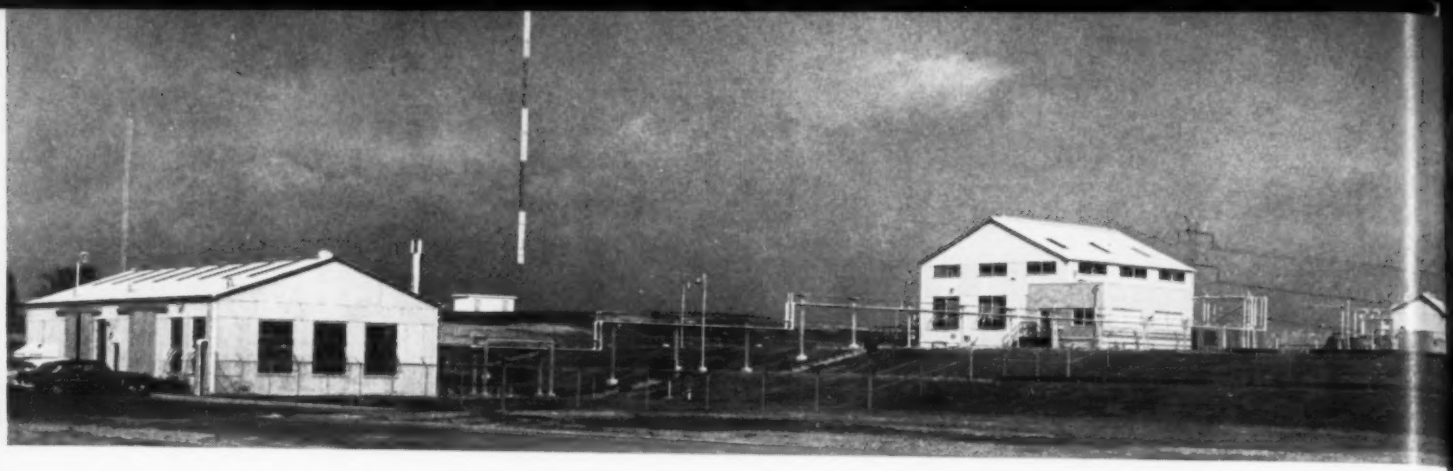
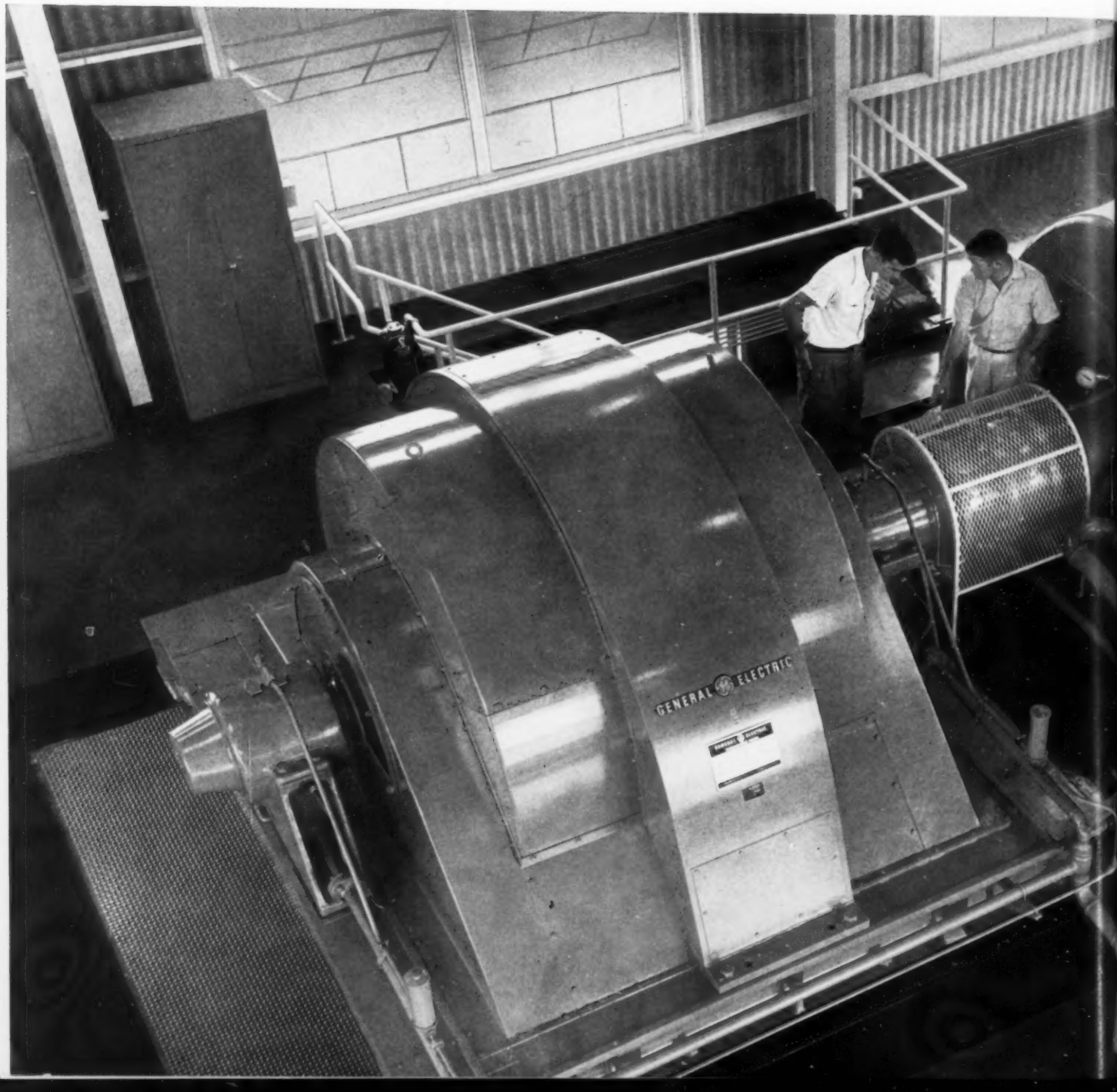
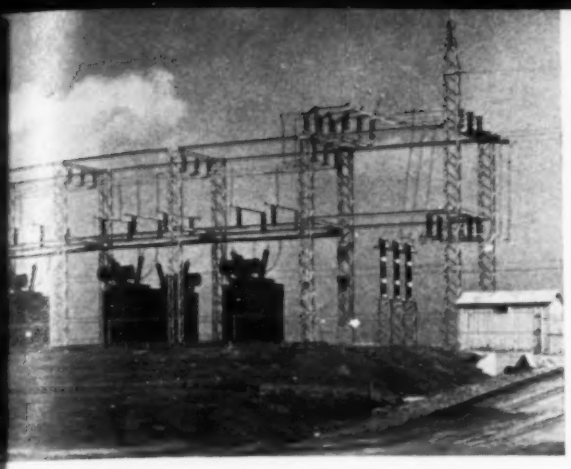
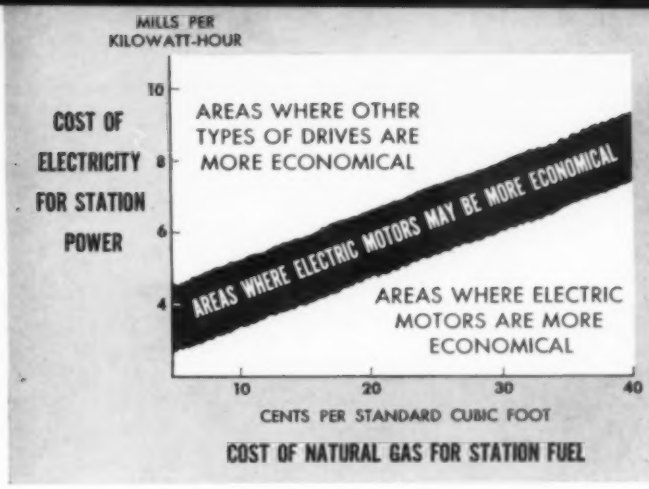


Before you select a pipeline c







...e compressor drive...

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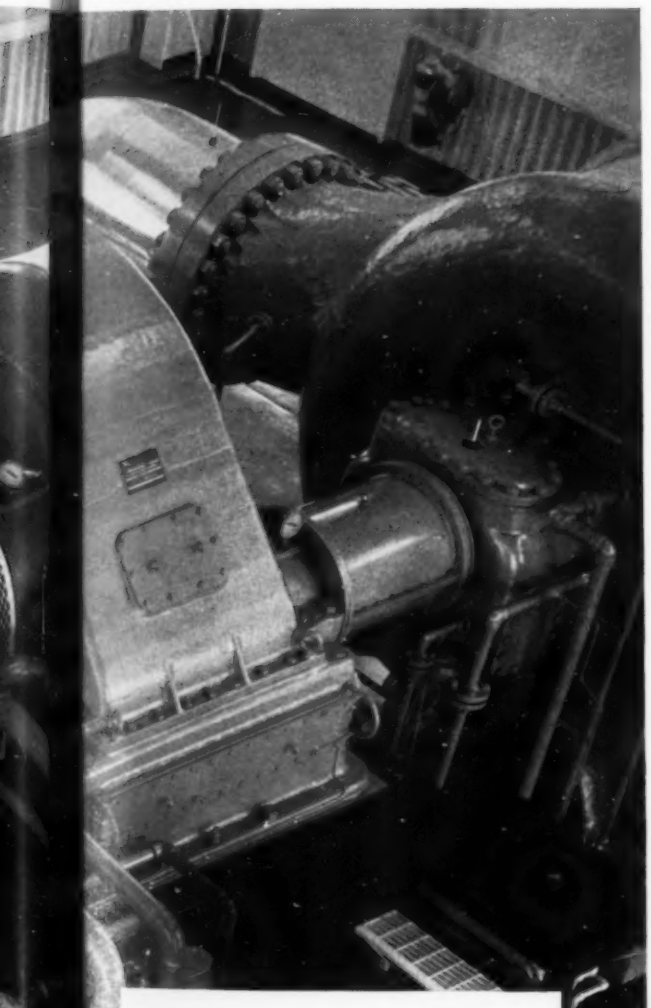

G-E 12,500-HP SYNCHRONOUS MOTOR and 900/4823 rpm gear driving compressor at new installation in North Carolina. This compressor station boosts typical summer volume of over one billion cubic feet of gas daily.

As the demand for natural gas increases, the use of electric power for driving pipeline compressors becomes more attractive. With low-cost electricity—readily available to pipeline companies in an increasing number of areas—General Electric high-speed synchronous motors give you these important advantages:

MAXIMUM RELIABILITY is inherent in the uncomplicated General Electric synchronous motor. Few moving parts, simple lubrication, and a pressurized air cooling system give you dependable, low-maintenance operation, day after day.

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AUTOMATIC CONTROL of the compressor station is enhanced by the simplicity and ease of control of the G-E electric-motor drive. In addition, General Electric can co-ordinate the motor, gear, station control, and remote supervisory control for a completely integrated system which can be operated from miles away.

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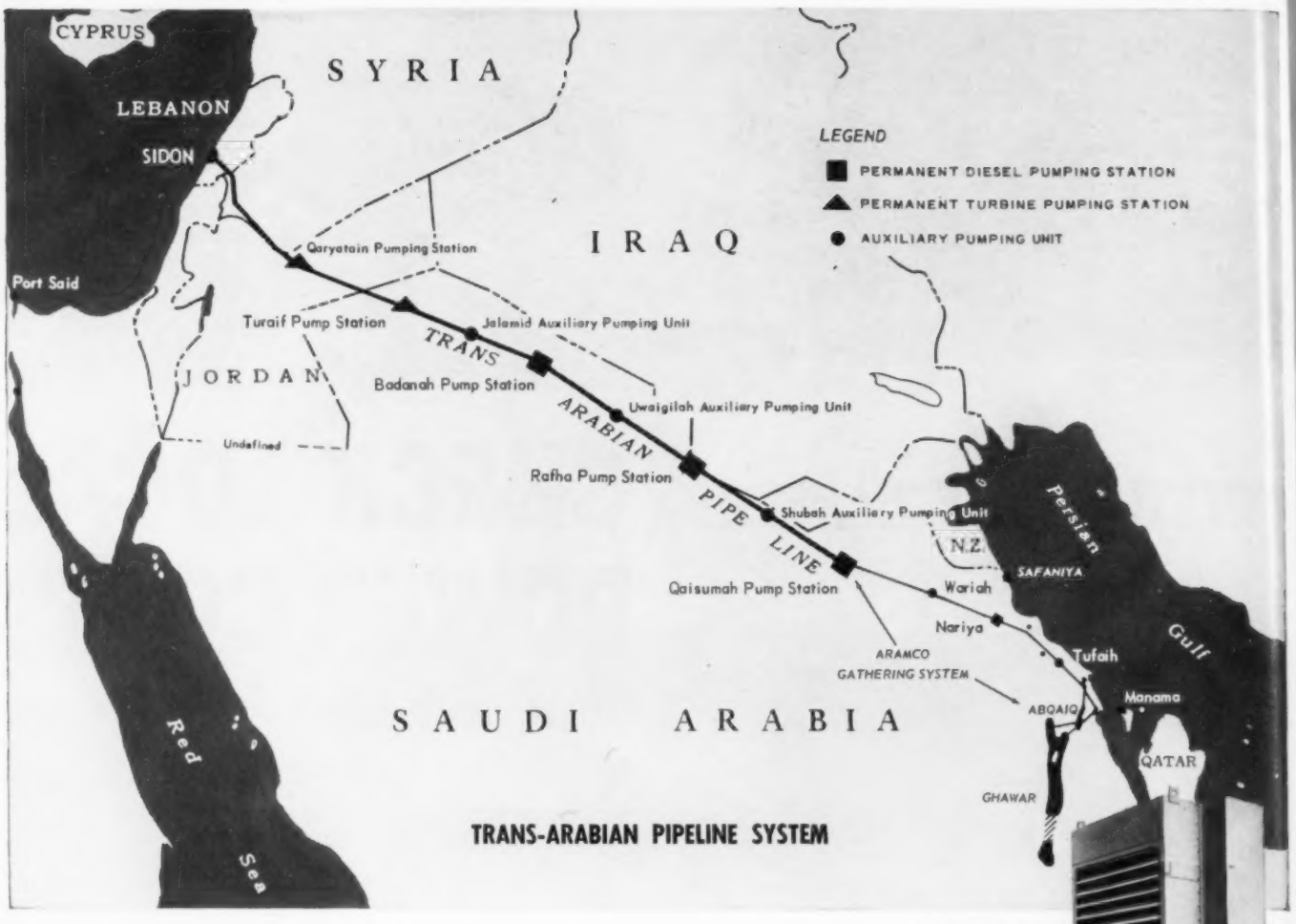

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AAF cleans dust-storm air along 1000-mile desert pipeline!

Dust storms and 120° temperatures are frequent along the 1068-mile trans-Arabian pipeline system—from oil fields near the Persian Gulf to the offshore loading terminal on Lebanon's Mediterranean coast.

In both unattended portable and permanent turbine pumping units along the vast line, power equipment capable of moving 460,000 bbl. per day is protected by *clean air* from AAF's high-efficiency, self-cleaning filters. The dust-free ventilating air in the unattended portable units also carries off excessive heat and oil vapors, minimizing the risk of igniting from hot turbine surfaces.

For Arctic regions and temperate climes (as well as arid deserts), AAF designs maintenance-free filters to provide clean intake air for the safe, efficient operation of your compressors and engines. For complete information, call your nearest AAF representative, or write direct for Bulletin 150. Address: Mr. Robert Moore, American Air Filter Company, Inc., 450 Central Avenue, Louisville, Kentucky.

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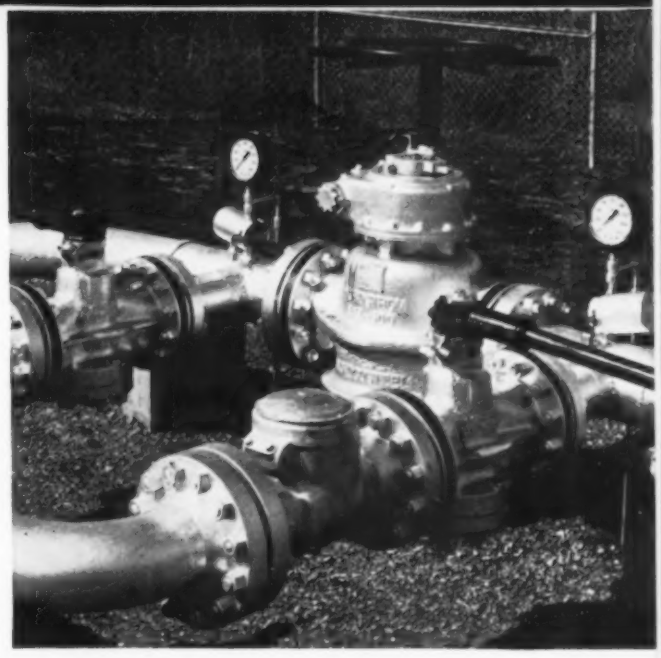

The Sealdport® pressurized lubrication system in Rockwell-Nordstrom plug valves actually repairs itself. The lubricant gives a continuous new seating surface. Under pressure, the lubricant is a powerful seal between the body and the plug. Like self-sealing auto tires, this seal can't be permanently cut, scratched or damaged. Rockwell-Nordstrom plug valves offer dependability and economy. Ask your J&L man for a Rockwell-Nordstrom catalog.

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If it's sold by J & L . . . .
It's the best available 106

Left, J&L Electricweld Line Pipe's lengths are uniformly round and line up end to end in perfect butt joints with uniform bevels for fast welding. The uniform high ductility of J&L Electricweld assures easier field bending. Descriptive literature is available from your local J&L man.

Taylor Forge welding fittings are backed by years of engineering and research. Here is an outstanding line of standard and special purpose fittings for pipeline use. The photo, taken at a pipeline station, shows the installation of Taylor Forge ells and flanges on first stage gas scrubbers. Your local Jones & Laughlin representative will be glad to give you illustrated literature on these quality welding fittings.

NEW compressor-carrying TD
steps-up "tack" and "hot-pass" w

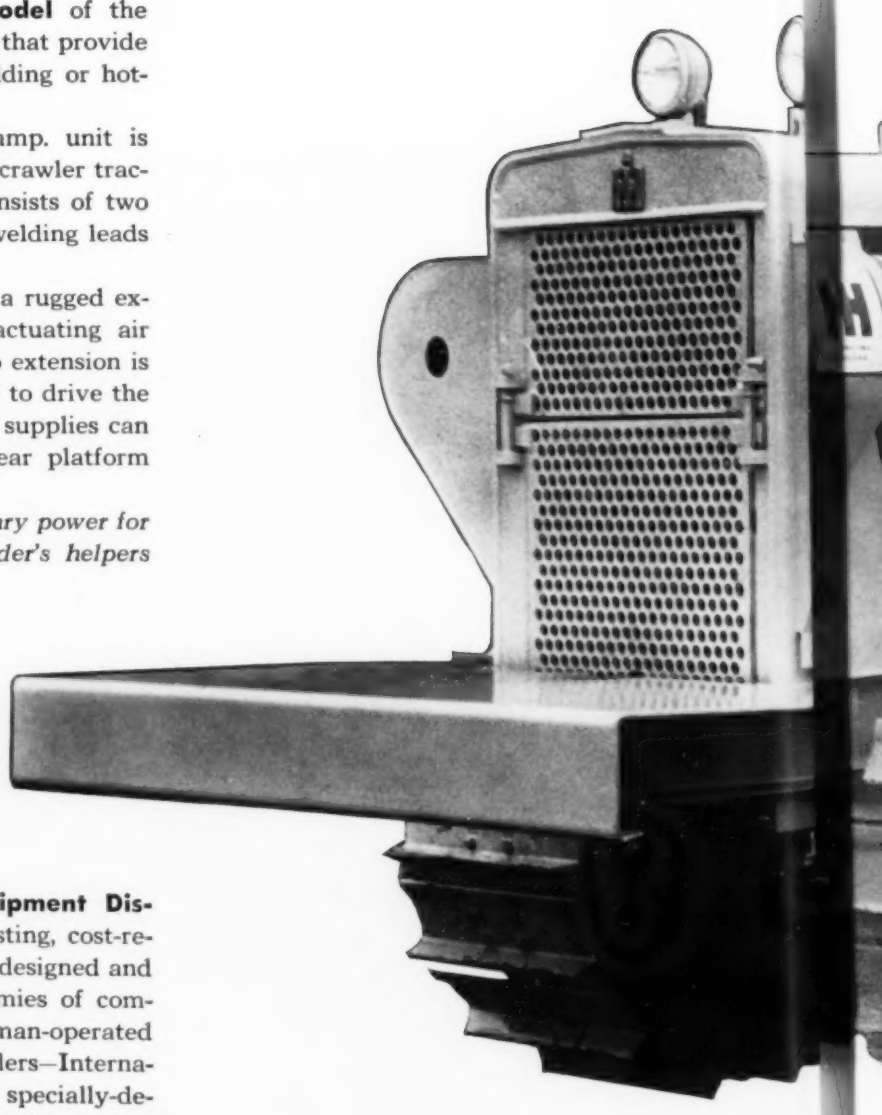
Now, International presents the 1961 model of the TD-15 Pay welder—with major improvements that provide greater efficiency than ever for your tack-welding or hot-pass welding crews.

This factory-engineered, high-output 325-amp. unit is powered and carried by the 6-cylinder TD-15 crawler tractor equipped to produce 120 int. hp. Unit consists of two Lincoln dual welders (4 welders), with four welding leads —V-belt driven from front pto.

In addition, the new Pay welder gives you a rugged extension platform for mounting your clamp-actuating air compressor. And as standard equipment, a pto extension is provided on which to mount the V-belt pulley to drive the compressor. Even your extra pipe clamps and supplies can be toted by the Pay welder on the large rear platform which is standard equipment!

You save the cost of skid mounts and auxiliary power for welders and compressor. Also, no extra welder's helpers are needed!

Self-contained and self-propelled, this spread-speeding, go-anywhere unit with 74-inch gauge tracks has the ground-hugging stability to operate on all terrain. For maximum flotation on swampy right-of-way, use maximum width (24-inch) track shoes. Positive sealing thoroughly protects vital working parts from dirt and moisture.



See your International Construction Equipment Distributor—see what it means in efficiency-boosting, cost-reducing performance to depend on this factory-designed and engineered welding unit. Measure the economies of combining four welders and compressor in a one-man-operated rig. Compare plus advantages like Dura-Rollers—International's 1,000-hr. lube interval track rollers, specially-developed to meet "eat 'em alive" pipelining conditions. Ask for a TD-15 Pay welder demonstration.

International® *Construction Equipment*

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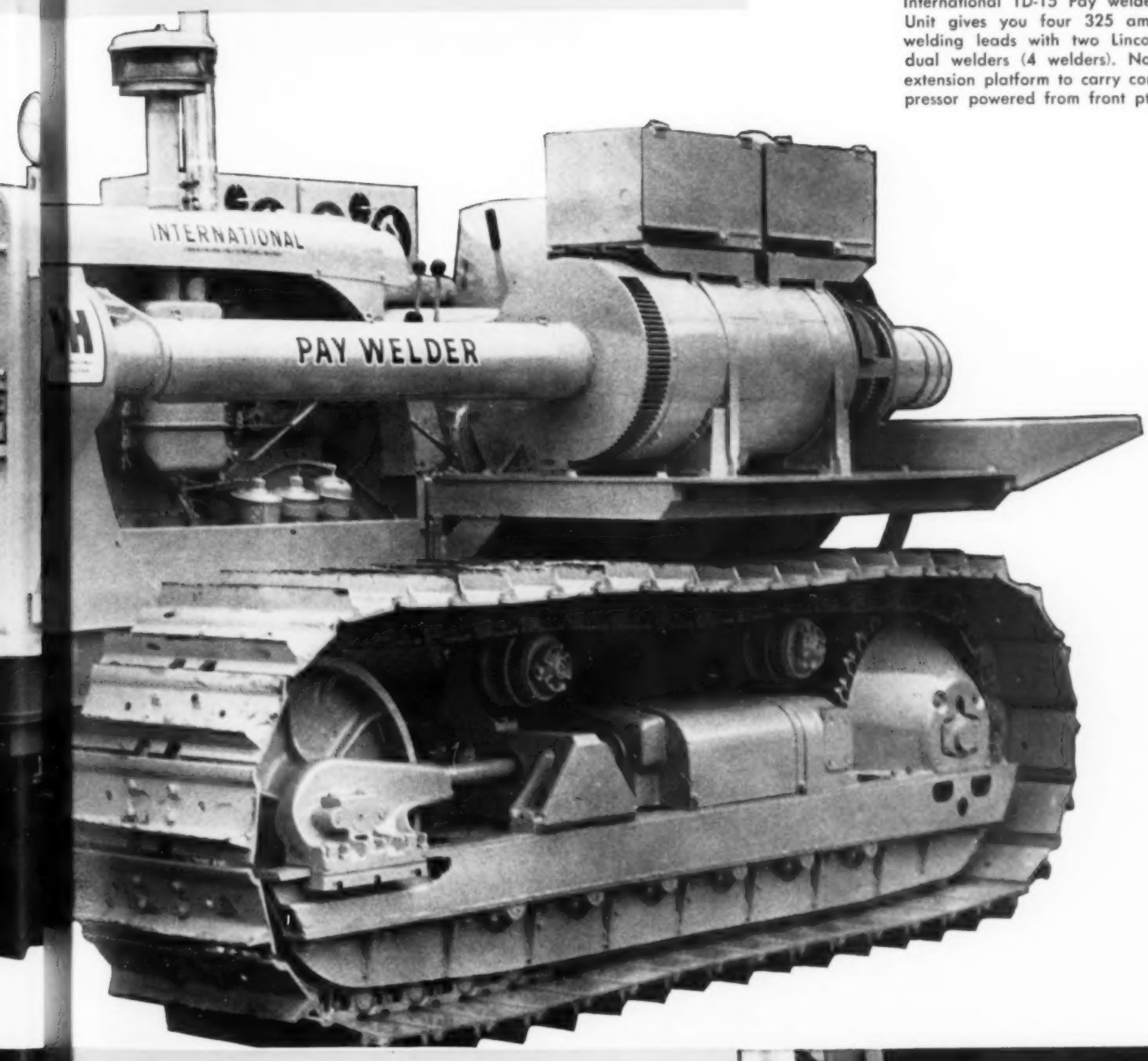
A COMPLETE POWER PACKAGE

g TD-15 PAY® WELDER
s' welding efficiency

Here's the new completely factory-engineered and built International TD-15 Pay welder. Unit gives you four 325 amp. welding leads with two Lincoln dual welders (4 welders). Note extension platform to carry compressor powered from front pto.



look into the Pay welder erator's compartment—showing the gged, engineered appearance of e unit and easy access for the erator. And note the read-easy dicator dials, and reach-easy con- ols of the tractor and welder com- onents.

Hinged radiator guard is removed to show pto pulley and V-Belt drives of Pay welder generators. Note pto extension to mount additional pulley to drive compressor mounted on front extension platform. Heavy-duty, sealed, dual-race ball bearings carrying the pulleys provide life-prolonging performance protection in the Pay welder.

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. . . IN ONE PIECE, WALKED INTO PLACE IN RUGGED SWAMP TERRAIN.
Practical engineers welded the overall mile length of 6⅝" O.D. x .188" wall thickness Cal-Metal Hi-Yield pipe on dry ground, then walked, dragged, pulled and pushed it into position. The 55-foot lengths resulted in fewer field welds; the lightness and bendability of this hi-yield pipe facilitated easier faster handling.
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PIPE LINE PANORAMA

United Gas to Manufacture and Sell Research Developments . . . There will be no "middle man" in manufacture and sale of research products United Gas Corporation wants to make available to industry. UGC's new Instrument Division will handle entire operation, rather than farm products out to manufacturers as some companies do now. Among new products to be put on the market:

Electronic chart reader . . . needs only one operator to read gas volume charts, make necessary calculations, record results on dial and tape.

Linear chart averager . . . needs only one operator to continuously average pressure, gravity, or temperature charts—handles most circular charts.

Miniature tape recorder . . . requires no manual transcription—can be used in production point-of-sale recording, stock and inventory control, and accounting.

Other products include: dewpoint detector—internal pipe line caliper that measures and records extent of internal corrosion in 4 to 36-inch lines—automatic relighters for oil and gas field heaters.

Federal Power Commission, Five Years Behind in Rate Cases, to Take a Month off . . . According to recent reports, FPC has 117 pipe line rate cases and 3,300 producer applications for price increases on the docket—at least five years' work. Yet, following practice of recent years, Commission has announced all August hearings will be suspended, except for emergencies.

Efforts to free producers from FPC control continue to move full steam ahead, despite little hope for Congressional action this year. Continental Oil's Vice President and General Counsel Lloyd Thanhouser estimates that out-of-pocket costs of being regulated by FPC borne by independent gas producers during past six years has amounted to at least $75 million.

Pipe Line Briefs . . . Vice President Nixon has gone on record favoring bill to free natural gas producers from FPC control, and 27½ percent depletion provision. Lyndon Johnson continues to speak out in favor of depletion provision. John Kennedy, in favor of reduced depletion percentage, has publicly announced support of National Fuels Policy study—**Proposed Mediterranean pipe line** from French Sahara's Hassi R' Mel gas field (30 trillion cubic feet of reserves) to northern Italy via Sicily is in engineering study stage; detailed survey of 77-mile Sicilian Channel bottom is now under way . . . **Recent Pipe Line Contractors Association payroll practices survey** reveals that 34 contractors pay employes once a week and 10 make out paychecks every two weeks; 24 contractors make up payroll at field office, 18 at home office, and two say they handle payrolls according to the job.

Mexico-Canada-Texas to Compete for California Gas Market? . . . Transwestern's $192 million investment to supply California with Texas natural gas via 1,200-mile pipe line faces stiff competition.

Federal Power Commission has started oral arguments on proposals to import huge quantities of Canadian gas from Alberta fields to U.S. markets. U.S. companies involved include Pacific Gas Transmission, El Paso Natural Gas, and Montana Power Company. Estimated cost of project: $400 million.

Meanwhile, Petroleos Mexicanos officials are seeking U.S. financial help to build gas line from Reynosa area on Gulf Coast to point near Mexico-California border town of Tijuana.

Flow Calculation Manual for Natural Gas Transmission Lines Is Under Development

By R. T. Ellington and W. R. Staats
Institute of Gas Technology, Chicago

THE NEED for more information on pipe line flow behavior resulted in an extensive research program by the Pipeline Research Committee of the American Gas Association. Under this program, detailed tests were made by the U.S. Bureau of Mines[9] and the Institute of Gas Technology.[10] These tests considerably improved the knowledge of flow behavior in large diameter transmission lines and clarified the influence of internal pipe wall roughness on flow behavior. The new information permits more accurate representation of the flow resistance for pipe lines than was previously possible. As a result, equations which represent the flow behavior of actual lines for a wide range of flow conditions have been selected.

Flow calculations for transmission systems fall into two general classifications. One is the detailed design calculation which must take into account all knowledge of the proposed or existing design and operating conditions. This type of calculation is frequently made by use of electronic computer equipment and the computation programs are usually exchanged by companies so that they are soon in the hands of all interested parties. The second type of calculation includes the many simpler situations associated with initial design considerations, looping and extension proposals and monitoring the operation of sections of existing systems. These are frequently repetitive calculations similar to those encountered in orifice metering. Many people felt that it would be helpful to the industry to have the equation representing flow in transmission lines reduced to the easily usable form of AGA Orifice Report No. 3. The development of a manual for carrying out calculations in this way is being done at IGT as part of AGA Pipeline Research Committee Project NB-13.

DEVELOPMENT OF THE FLOW EQUATION

The General Flow Equation. The equation below provides a sound basis for the discussion of flow behavior, since the theoretical and experimental efforts to be summarized have been carried out to learn more about specific terms in it. The equation for constant-temperature, steady-state flow in a pipe line with no elevation change, for an average value for the compressibility factor, is

$$Q_b = 38.77 \frac{T_b}{P_b} \sqrt{\frac{1}{f}} \left[\frac{P_1^2 - P_2^2}{GTLz} \right]^{0.500} D^{2.500} \qquad (1)$$

This form is the one most commonly used to present flow equations. Examination of the flow equations presented by various authors shows that they differ primarily in representation of the transmission factor, $\sqrt{1/f}$, which defines the energy lost in resistance to flow for various pipe and flow conditions.

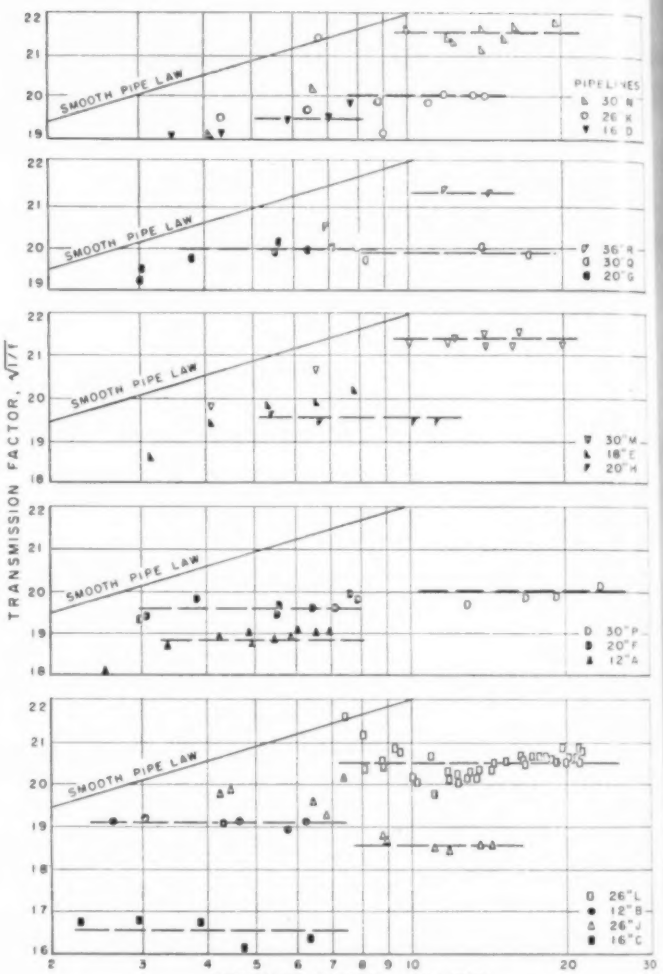

FIGURE 1—Variation of the transmission factor with Reynolds number for natural gas transmission pipe lines.

Experimental Work on Flow Resistance. Work in this field has been carried out by a great number of investigators. The results correlated smoothly with the Reynolds number for a wide range of flows; however, as the flow rate is increased further, the data exhibit a tendency to level off so that the transmission factor no longer depends on Reynolds number. The leveled off values can be correlated in terms of roughness ratio, k/D as described in previous work.[3,9,10]

Data obtained for 16 natural gas transmission lines ranging from 12 to 36 inches in diameter showed that the transmission factor was independent of flow rate for all flows that could reasonably be obtained for long distance transmission lines, Figure 1.[10]

If all the experimental evidence on flow in pipes is

taken into account, one may conclude that in addition to laminar behavior, two major types of turbulent flow can exist in pipes. The type of turbulent flow which develops after the transition from the laminar region is usually termed *smooth-pipe* flow because wall effects are not present. For this the flow resistance is a function only of Reynolds number. This type of behavior was fitted by equations of the Blasius and Mueller type.

The type of flow existing at very high Reynolds numbers is usually termed *fully-turbulent* flow and for this the flow resistance depends on the pipe diameter and wall roughness, and not on flow rate. The Weymouth equation fits this type of behavior; the new Panhandle equation deviates from it only slightly. As mentioned above, most natural gas transmission lines operate under conditions of fully-turbulent flow.

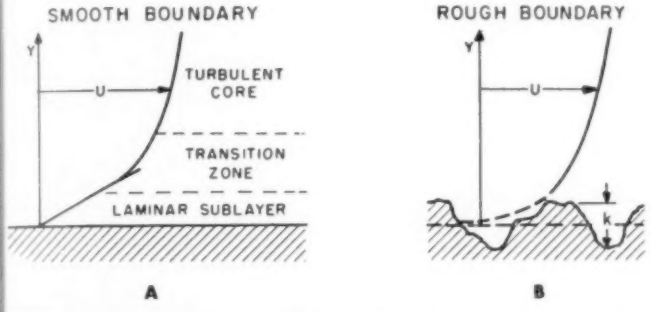

FIGURE 2—Profile of turbulent flow in smooth wall pipe (left). Laminar sublayer decreases in thickness as velocity increases. Right is profile of turbulent flow as velocity increases and laminar sublayer has decreased to the point that peaks of wall roughness extend through it.

Analytical Work on Flow Resistance. For laminar flow in a pipe, the boundary layer may be considered to extend clear to the center of the pipe, and the velocity profile is parabolic. In turbulent flow, the momentum is transferred in the fluid by swirl or eddy motion in addition to the shear found in laminar flow. The profile is essentially that in Figure 2A. As the velocity of flow is increased, the laminar sublayer (which is laminar) decreases in thickness and eventually a rate is reached at which peaks of wall roughness extend through the laminar sublayer into the turbulent core of flow, Figure 2B. In this case, combination of the velocity profile curve and the drag coefficient relationship can yield a transmission factor for turbulent flow near smooth boundaries. It can be expressed:

$$\sqrt{1/f} = 4 \log (N_{Re}/\sqrt{1/f}) - 0.6 \qquad (2)$$

and that for turbulent flow near rough boundaries is

$$\sqrt{1/f} = 4 \log 3.7D/k \qquad (3)$$

These equations lead to exactly the same conclusions as obtained by the experimental approach and represent the experimental data with surprising accuracy. The first gives the Reynolds number dependence of smooth-pipe behavior and represents all valid data available for this type of behavior. Equation 3 describes the behavior for fully-turbulent flow, i.e., dependence on wall roughness and pipe diameter and not on flow rate, Figure 1.

Recommended Equations. The transmission factor expressions were determined on a sound basis; and they take into account all of the variables known to influence flow. Substituted into Equation 1 which represents the energy balance for steady pipe flow, they give flow equations of any desired accuracy. The smooth pipe flow equation resulting from substitution of Equation 2 in Equation 1 has been compared with other gas flow equations used primarily for distribution system design.[12] The form of Equation 2 was modified to give an expression that fits smooth pipe behavior from Reynolds numbers of 25,000 to 1,600,000 and is excellent for network flow calculations.

The equation resulting from substitution of Equation 3 into Equation 1, accurately represents the fully-turbulent flow encountered in most transmission lines. Therefore, the calculation procedures and recommendations to be developed relate to, and should be understood to be limited to, fully-turbulent flow in pipe lines of such length that entrance losses can be neglected, at sufficiently low-velocities that changes in kinetic energy can be considered zero.

Investigation of Pipe Roughness. The picture is yet incomplete regarding the relation between the measured roughness of a surface and the effective roughness to flow of the inside of a pipe line. Nikuradze used tubes with roughnesses manufactured by cementing sand grains to their walls, producing surfaces of much greater roughnesses than that of commercial steel pipe. It is remarkable that he had to modify the constants of the theoretical equation only slightly to obtain Equation 2, which fitted his data.

Of the experimental flow data available, Smith's[9] were obtained with surfaces which correspond most closely to those of natural gas pipe lines and under conditions which eliminated the effects of bends and joints. The Institute of Gas Technology obtained specimens of the various commercial pipes used by Smith, et al, and made measurements of the surface roughness.[6]

When calculated values of effective pipe wall roughness for the data of Smith were compared with those of IGT's field tests, very little difference was noted. This seemingly indicates that the friction effects of bends and joints in commercial gas pipe lines are negligible.

Recently, commercial instruments for making roughness measurements on surfaces became available. One of these employs a small stylus and a phonograph-type pickup. Measurements made with this instrument show good agreement with the replica method and with the calculated effective roughnesses of actual pipe lines. The effects of yard weathering of pipe, deposits in the line, and cleaning operations can be related directly to the effective roughness of the pipe wall. Therefore, it is most important that more experimental data be obtained on the effective roughness of transmission lines for various types of treatment and service. Especially great is the need for more data on the effective roughness of internally coated pipe.[11]

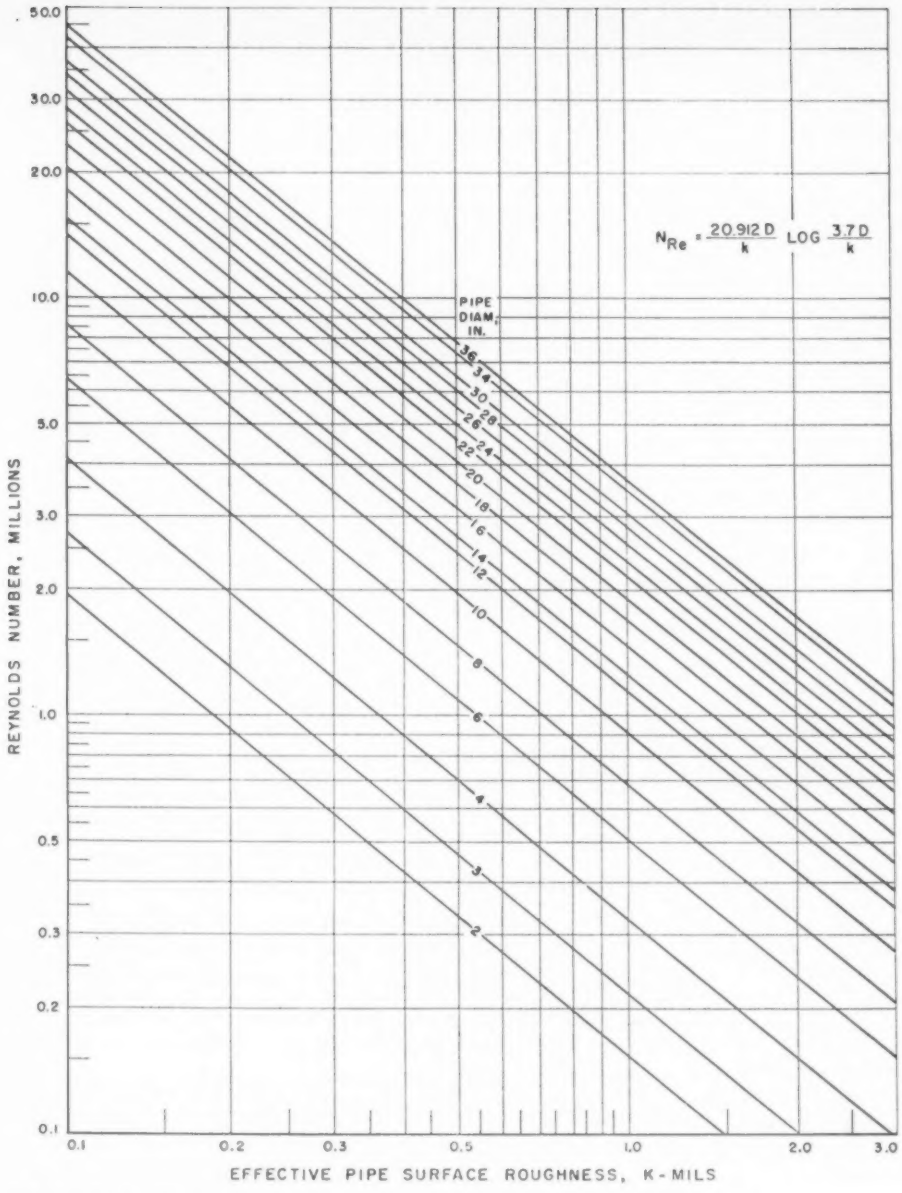

FIGURE 3—Reynolds number for onset of fully turbulent flow for various pipe diameters and roughness. Median wall thickness of various sizes of pipe were used.

Transition Region. Several types of transition from smooth-pipe to fully-turbulent flow have been observed.[9] Yet there is not enough information now available to predict the transition behavior for gas in pipes. However, Smith, et al, show that, within the limits of experimental accuracy, the deviation of the transition curve from the fully-turbulent law can be completely disregarded. Thus, complete fully-turbulent behavior may be assumed to exist down to the flow rate at which smooth-pipe behavior must exist.

The points designated as minimum flow rates to be used with the calculation procedures in the manual on computing flow were obtained by substituting the expression for the transmission factor for fully turbulent flow into the expression for the transmission factor for smooth-pipe flow. This gives the equation for transition points in terms of Reynolds number, pipe diameter and surface roughness:

$$N_{Re} = \frac{20.912D}{k} \log \frac{3.7D}{k} \qquad (4)$$

There are the lowest Reynolds numbers for a given pipe geometry for which the proposed calculation manual can be used. These are presented in Figure 3. A mid-range internal diameter was selected to represent each size of pipe (Table 1).

TABLE 1—Pipe Size Representation

Nominal Pipe Size, Inches	Range of Inside Diam., Inches	ID Used To Represent This Group
2	1.689— 2.067	1.939
3	2.300— 3.068	2.626
4	3.152— 4.260	3.826
6	4.897— 6.357	5.761
8	6.813— 8.329	7.625
10	9.564—10.344	10.020
12	11.376—12.312	11.938
14	12.814—13.500	13.126
16	14.688—15.500	15.062
18	16.876—17.500	17.188
20	18.814—19.500	19.188
22	21.000—21.500	21.250
24	22.626—23.500	23.062
26	25.000—25.500	25.250
28	27.000—27.500	27.250
30	29.000—29.500	29.250
34	33.000—33.500	33.250
36	35.000—35.500	35.250

About the Authors

Ellington

Staats

Dr. Rex T. Ellington, assistant research director and chairman of the education program of the Institute of Gas Technology, was graduated from the University of Colorado in 1943. He studied under IGT fellowships for his master's degrees in both chemical engineering and gas technology which were awarded him in 1949. He received a Ph.D. from Illinois Institute of Technology in 1953. During World War II, he was an electronics officer in the air arm of the U.S. Navy. Prior to joining the staff of IGT he worked in the Engineering Department of the Boston Gas Co. for a year and with the Chattanooga Gas Co. for two years. He has been with IGT since 1954. Ellington is an active member of the AIChE, AIME and the AGA.

William R. Staats received his Bachelor's degree in chemical engineering from Illinois Institute of Technology in 1957. He was employed as an assistant instructor and junior engineer at IGT. He obtained his master's in gas engineering in 1960 and is now on military leave.

Reynolds Number Calculations. The flow rate at which the transition from smooth-pipe to fully-turbulent flow occurs is given in terms of Reynolds number in Figure 3. Thus, once a flow rate has been calculated a check may be necessary to determine whether fully-turbulent flow exists and the proposed procedures are applicable. In most cases, the Reynolds number need not be calculated with extreme accuracy, so a number of approximations may be used. The Reynolds number is defined

$$N_{Re} = \frac{Du\rho}{12\mu} = \frac{Du_b\rho_b}{12\mu} \qquad (5)$$

where

$$u_b = \frac{576{,}000\ Q_b}{D^2 \times 24 \times 3600} = 2.122\ Q_b/D^2$$

$= $ gas velocity for base conditions, ft/sec.

$\rho_b = $ gas density at base conditions, lb/cu ft.

$\mu = $ gas viscosity at flowing conditions, lb/ft sec.

$= 6.72 \times 10^{-4} \times$ viscosity in centipoises.

The density may be obtained, with acceptable accuracy from,

$$\rho_b = \frac{1}{V_b} = \frac{28.97\ G\ P_b}{10.73\ T_b} \qquad (6)$$

The viscosity, μ, is often assumed to be 8×10^{-6} lb/ft sec for light natural gases under representative transmission conditions. More precise estimation may be made by use of information on the gas composition and the methods presented by Carr.[4]

Using the above approximations

$$N_{Re} = 59{,}680 \times Q_b\ G\ P_b/DT_b \qquad (7)$$

DEVELOPMENT OF THE COMPUTATION MANUAL

Recommended Form For Flow Equation. The equation for fully-turbulent flow, should be expressed in a form that can be easily applied to routine calculations by individuals without technical training and used to facilitate calculations for the engineer. The first step in developing the proposed computation manual is to break the equation down into terms for which values can be tabulated.

Substitution of the transmission factor expression into Equation 1 gives

$$Q_b = 0.038774\ \frac{T_b}{P_b}\left[\frac{P_1^2 - P_2^2}{GT_{avg}z_{avg}L}\right]^{0.500} D^{2.500}\ 4 \log\frac{3.7D}{k} \qquad (8)$$

for the basic flow equation for steady-state fully-turbulent flow. This is easily rearranged to give:

$$Q_b = 0.038774\ \frac{T_b}{P_b}\left[\frac{1}{GT_{avg}z_{avg}}\right]^{0.500} D^{2.50}$$

$$4\left[\log\frac{3.7D}{k_{750}} + \log\frac{k_{750}}{k_{act}}\right]\left[\frac{P_1^2 - P_2^2}{L}\right]^{0.500} \qquad (9)$$

Next, the equation is separated and the various terms symbolized for simple table evaluation. The inclusion of a flow efficiency term results in a relationship that can be used for almost any type of design or operating problem.

$$Q_b = 0.030998\ F_{tb}\ F_{pb}\ F_{gr}\ F_{tf}\ F_z\ F_d\ (F_{fb} + F_{fa})\ F_{pp}\left[\frac{P_1^2 - P_2^2}{L}\right]^{1/2} \qquad (10)$$

In this equation,

$Q_b = $ Flow at base conditions, Mcfd

$F_{tb} = T_b/520$ (Identical to F_{tb} in Meter Report No. 3.) It is applied to change the base temperatures from 60° F to a required (contract) base temperature.

$F_{pb} = 14.73/P_b$ (Identical to F_{pb} in Meter Report No. 3.) It is applied to change the base pressure from 14.73 psia to a required (contract) base pressure.

$F_{tf} = (520/T_{f,avg})^{1/2}$ (Identical to F_{tf} in Meter Report No. 3, based on average flowing temperature.) It is applied to change from the assumed average flowing temperature of 60° F to the actual flowing temperature.

$F_{pv} = (1/z_{avg})^{1/2}$ (This is the same term as F_{pv} in Meter Report No. 3, and the method given in the Report may be used to evaluate the term within the accuracy of the equation.) It is identical to the F_{pv} factors in *Supercompressibility Factors for Natural Gas*, 7 vols., AGA, N.Y.,[2] (1955).

$F_{gr} = (0.600/G)^{1/2}$ This factor is based on a gravity of 0.600, rather than the value of 1.000 used in Meter Report No. 3, so that the basic equation can be used for quick approximations. It is used to change from the assumed gas gravity of 0.600 to the actual gas specific gravity.

$F_d = D^{5/2}$ This is based on the actual internal diameter of the pipe. It will be tabulated for the internal diameters represented by the wall thicknesses normally available for a given diameter pipe.

$F_{fb} = \log\frac{3.7D}{0.750 \times 10^{-3}}$ This is the base transmission factor term representative of clean wellpigged pipe line. The base effective roughness is 0.750 mils, or 750 microinches.

$F_{fa} = \log\frac{750}{k_{actual}}$ This converts the transmission factor for the base effective roughness to that for the actual effective roughness when it is known.

$F_{pp} = $ Performance Factor This is analogous to the flow efficiency of the line.

$\left[\frac{P_1^2 - P_2^2}{L}\right]^{1/2} = $ Pressure Gradient Term, which takes the actual operating conditions into account.

The computation manual will contain tabulations of all of the *factors* listed above. Some of these tables will obviously be the same as the corresponding tables in Orifice Meter Report No. 3.[1] The new tables will be set up to cover the full range of conditions encountered in normal operations. Instructions will be provided for calculating the factor for other conditions.

Roughness Values and the Roughness Factors. In developing the manual, it must be admitted that infor-

mation is yet incomplete regarding the effective roughness values to be used for pipe lines under various conditions. At the present time only representative roughness values can be suggested. It can be said that a value of about $k = 700 \times 10^{-6}$ inches probably represents clean straight pipe with smooth welds. Also $k = 750 \times 10^{-6}$ inches probably represents a good value for a pipe line recently pigged and with no liquid or solid deposits. Relatively close agreement has been found between measured and effective roughness in certain cases. Measured values for various conditions are given in Table 2. As more information becomes available auxiliary tables will be released for use with these procedures.

TABLE 2—Surface Roughness Measured With Stylus-Type Instrument

New pipe at mill	0.450 mil
Pipe in use, different locations and suppliers, average	0.760 mil
6 mo. atmospheric exposure	1.1 —1.300 mil
12 mo. atmospheric exposure	1.400 mil
24 mo. atmospheric exposure	1.600 mil
Epoxy internally coated line	0.25—0.300 mil

The roughness factor—actual, can be used to correct the value for base conditions and to calculate an effective roughness from tests on a given line. The latter can then be used as an index of line condition to determine when pigging and cleaning operations are in order. Many companies will continue to use the flow efficiency as an index of line condition. The performance factor, F_{pp}, could be used in the same way in monitoring operation; it could also be used in design problems. The equation gives the maximum delivery of the line for a given set of conditions. Often it is desirable to modify this value for engineering representations, which can be done by using this factor.

Compressibility Factor Terms. In the flow equation the compressibility factor appears in the term $\sqrt{1/z}$, which is denoted F_z. The method to be used for evaluating this term in the computation manual is based on the behavior of a representative 0.600 gravity hydrocarbon gas. The well-known AGA tables can be used to predict F_z for other gases.

Equivalent Sections. It is frequently convenient to consider the complex line sections as being replaced by a fictitious "equivalent" line (i.e., a single line of a convenient or specified diameter and of such a length as to have the same flow characteristics as the actual line or lines). Thus, looped lines and lines with sections of different diameters can be replaced by an "equivalent" line to determine how the throughput would vary for different operating conditions.

For two parallel lines operating between points at the same pressure, the equivalent section must have a capacity equal to the sum of the capacities of the parallel sections and must be assumed to have a certain roughness and a certain length. Assuming that the average compressibility factor for the two sections is the same and that their surfaces may differ gives:

$$\left[\frac{D_e^{2.5}}{L_e^{0.5}}\log\frac{3.7D_e}{k_e}\right]=\left[\frac{D_1^{2.5}}{L_1^{0.5}}\log\frac{3.7D_1}{k_1}\right]+\left[\frac{D_2^{2.5}}{L_2}\log\frac{3.7D_2}{k_2}\right] \quad (11)$$

$$\left[\frac{F_{d_e}(F_{fb_e}+F_{fa_e})}{L_e^{0.5}}\right]=\left[\frac{F_{d_1}(F_{fb_1}+F_{fa_1})}{L_1^{0.5}}\right]+\left[\frac{F_{d_2}(F_{fb_2}+F_{fa_2})}{L_2^{0.5}}\right] \quad (12)$$

which is solved for the equivalent diameter by trial and error. When the lengths and roughness of all sections are the same the relationship reduces to

$$\left[D_e^{2.5}\log\frac{3.7D_e}{k}\right]=\left[D_1^{2.5}\log\frac{3.7D_1}{k}\right]+\left[D_2^{2.5}\log\frac{3.7D_2}{k}\right] \quad (13)$$

or

$$[F_{d_e}(F_{fb_e}+F_{fa_e})]=[F_{d_1}(F_{fb_1}+F_{fa})]+[F_{d_2}(F_{fb_2}+F_{fa})] \quad (14)$$

For consecutive sections of different diameters, roughnesses and lengths, the flow through each section is the same, so that, for an assumed equivalent length (usually the sum of the section lengths) and roughness,

$$\left[D_e^{2.5}\log\frac{3.7D_e}{k_e}\left[\frac{P_1^2-P_3^2}{L}\right]^{0.5}\right]=\left[D_1^{2.5}\log\frac{3.7D_1}{k_1}\left[\frac{P_1^2-P_2^2}{L_1}\right]^{0.5}\right]=\left[D_2^{2.5}\log\frac{3.7D_2}{k_2}\left[\frac{P_2^2-P_3^2}{L_2}\right]^{0.5}\right] \quad (15)$$

$$F_{d_e}(F_{fb_e}+F_{fa_e})\left[\frac{P_1^2-P_3^2}{L_e}\right]^{0.5}=F_{d_1}(F_{fb_1}+F_{fa_1})$$

$$\left[\frac{P_1^2-P_2^2}{L_1}\right]^{0.5}=F_{d_2}(F_{fb_2}+F_{fa_2})\left[\frac{P_2^2-P_3^2}{L_2}\right]^{0.5} \quad (16)$$

FIGURE 4—Pipe lines in parallel

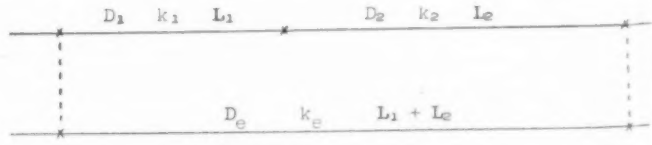

FIGURE 5—Pipe lines in series

The Effect of Errors in Various Quantities. The calculated flow rate will reflect errors in various quantities in the equation to different degrees. It is not subject to error from F_{pb} and F_{tb}. The effect of error in the other quantities will be taken up as they occur in the equation. This discussion may be expanded in the manual.

Mathematically the relative error in flow rate, Q for a given error in the measured quantity is:

$$\frac{\Delta Q}{Q} = \frac{[\partial Q/\partial(\text{quantity})]\,\Delta(\text{quantity})}{Q} \qquad (17)$$

where $\Delta Q/Q$ = fractional or relative error in flow rate. From this the relative error produced in Q can be found by examining each term in the equation shown in Table 3. Treatment of the variation in P is more difficult and has been fully covered elsewhere.[3]

TABLE 3—Relative Error in Calculated Flow Rate Resulting From An Error in the Quantity Given

Quantity	Relative Error in Quantity	Relative Error in Calculated Flow Rate
G	0.01	0.005
T_f	0.01	0.005
z	0.01	0.005
L	0.01	0.005
D	0.01 (D = 1.689, k = 1 mil)	0.026
	0.005 (D = 1.689, k = 1 mil)	0.013
	0.005 (D = 35.500, k = 0.5 mil)	0.013
k	0.01 (D = 1.689, k = 1 mil)	0.0011
	0.10 (D = 1.689, k = 1 mil)	0.0114
	0.10 (D = 35.500, k = 0.5 mil)	0.0082

Elevation Effect Considered. The calculation procedures discussed up to this point have been based on lines with terminal points at the same elevation. The engineer concerned with detailed design problems will be confronted with situations in which elevation change must be considered. In this event the complete equation must be employed:

$$Q_b = 0.30998\, F_{tb} F_{pb} F_{gr} F_{tf} F_z F_d\, (F_{fb} + F_{fa})\, F_{pp} \left[\frac{(P_1^2 - P_2^2) - 0.0375\, \Delta h P_{avg}^2 F_z^2 F_{tf}^2}{L}\right]^{0.500} \qquad (18)$$

It can be seen that the tables to be developed for the manual will be of considerable help in this case also.

Summary. Knowledge of the flow behavior of natural gas transmission lines is now sufficiently complete that a basic equation can be recommended that takes into account the full range of the variables known to be important. It especially includes the effective roughness of the pipe wall. This equation has been put in a form similar to that of the orifice flow equation so that sets of tables can be employed to facilitate calculations as in using Orifice Meter Report No. 3. It is hoped that this discussion of the proposed manual will bring suggestions for improvement so that it will be of maximum benefit to the entire industry.

NOMENCLATURE AND PHYSICAL CONSTANTS

Symbol		Units
D	Inside diameter of pipe line	Inches
F_d	Pipe line diameter factor	$\text{Inches}^{2.5}$
F_{fa}	Surface roughness factor—actual roughness	None
F_{fb}	Surface roughness factor—base roughness	None
F_{gr}	Specific gravity factor	None
F_{pb}	Pressure base factor	None
F_{pp}	Pipe line performance factor	None
F_{tb}	Temperature base factor	None
F_{tf}	Flowing temperature factor	None
F_z	Compressibility factor term	None
f_{pg}	Pressure adjustment index, specific gravity method of F_z determination	None
f_{ph}	Pressure adjustment index, heating value method of F_z determination	None
f_{tg}	Temperature adjustment index, specific gravity method of F_z determination	None
f_{th}	Temperature adjustment index, heating value method of F_z determination	None
G	Specific gravity of gas. Dry air = 1.000	None
g_c	Gravitational constant	None
H_w	Total heating value of gas at 60°F, 30 in. Hg, saturated with water vapor	Btu/Cu ft
Δh	Elevation change	feet
$\Delta h'$	Energy loss in ft. of flowing fluid	feet
k	Avg. height or roughness peak	Micro inches
L	Length of section	miles
N_{Re}	Reynolds number	None
P_f	Average flowing pressure	psig
P_1	Pressure at inlet of line section	psia
P_2	Pressure at outlet of line section	psia
ΔP	Pressure adjustment	psig
P_b	Absolute pressure at reference or base condition	psia
Q_b	Volumetric rate of flow at base conditions	Mcfd
T_b	Absolute fahrenheit temperature at reference or base condition, $t_b + 460$	°R
t_b	Fahrenheit temperature at reference or base condition	°F
T_f	Absolute temperature of flowing fluid, average	°R
ΔT	Temperature adjustment	°F
u	Linear velocity	ft/sec
x_c	Mole fraction carbon dioxide in gas, mole percent/100	None
x_n	Mole fraction nitrogen in gas, mole percent/100	None
μ	Absolute viscosity of gas at flowing conditions	lb/sec ft
Δ	Denotes increment	
∂	Partial differential operator	
σ	Standard deviation	

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Why the Pipe Line Industry Should Take an Active Part In 1960 Political Campaigns

At least 10 issues affecting oil and gas will be brought before the 87th Congress. Here is the political history, plus a look ahead, for each of those issues

A NEW PRESIDENT, new Cabinet and new Congress are in store for Washington in 1961—and that adds up to a crucially important year for the oil and natural gas industry.

For the industry, this has been a do-nothing Congress. A lion's share of the industry's problems are Washington problems, and they will be around next year.

Many within the industry gave strong political backing to President Eisenhower in his two successful bids for the White House. But the record of his eight years as chief executive includes among major accomplishments for the industry only the mandatory oil imports program, which remains controversial, and the tidelands quitclaim act, which his Justice Department had been shooting at in the U.S. Supreme Court.

At least 10 issues vital to the oil and gas industry remain to be acted upon, including:

Natural gas bill

President Eisenhower vetoed the Harris Natural Gas Bill because of a sensational political scandal, while stating that he approved of the principle involved in the legislation.

The five key men who had paid big prices in energy, political deals and persuasion to get the bill through Congress—House Speaker Sam Rayburn (D-Tex.), Representative Oren Harris (D-Ark.), Senator Lyndon B. Johnson (D-Tex.), Senator J. William Fulbright (D-Ark.) and Senator Mike Monroney (D-Okla.)—refused to undertake another effort to get the bill through Capitol Hill without an ironclad agreement from President Eisenhower that he not only would sign such a bill into law, but also would assist them in rallying House and Senate support within the GOP. The White House never gave such assurance.

Evidence is clear that the natural gas bill freeing independents from Federal Power Commission control can never become law over a Presidential veto. Whether it can even get through Congress again without further compromises in its language is questionable. But it is obvious that if there is a President elected this Fall who is favorable to such legislation, an effort will be made to get it passed by Congress. If the new President is a foe of such a bill, no effort will be made in Congress.

Among the major candidates, only Vice President Richard M. Nixon and Senator Lyndon B. Johnson have voted for the gas bill. The views of Adlai E. Stevenson and Governor Nelson A. Rockefeller aren't known because they have never stated them publicly and haven't served in Congress.

Percentage depletion

The percentage depletion issue will definitely be back in 1961. In a new Administration, a new major tax bill is almost a certainty. Over the years, the continuing fight to save this provision within the tax law has been, perhaps, the roughest the industry has had on the Washington scene. But it is a battle the industry always has won.

Despite the fact the vote has never been too close for comfort yet, the fear that Congress eventually will alter the provision is a pressing one. On this issue, the industry needs every Congressional friend it can find, not to mention a sympathetic President and Treasury Department.

Odds are overwhelming that a move to reduce the depletion percentage will be put to a vote in the Senate in 1961.

Until now, Speaker Rayburn has blocked all attempts to bring the issue to a House vote. With his vast power—which he knows how to use in such instances—Rayburn may succeed again. It can't be stopped from being offered

in the Senate where a different parliamentary situation prevails. But if the Senate ever adopted such a tax change, Rayburn would be hurled into another position and couldn't block House consideration of it.

It is possible that the 1961 effort may be to reduce the depletion provision on foreign oil production. Even some Senators and Congressmen normally very friendly to the oil industry support this proposal. But industry lobbyists in Washington consider it a deadly precedent, arguing that depletion must be defended as a principle, which is impossible if the provision is permitted for domestic production but disallowed for foreign production.

Federal highway program

The financing of the big federal highway program will raise its troublesome head again next year. This could, of course, result in further changes in the gasoline tax, already higher than the industry had expected.

Antitrust

While it probably will have no relation to Congress (although there could be legislation within the area), the antitrust bugaboo lies on the horizon of a new Administration. A Tulsa federal court threw out the present Administration's effort to nail 29 major oil companies on price-fixing charges.

When a new Administration comes in—as will be the case in 1961—there is always the temptation for extra muscle flexing in the antitrust field.

Among other oil and natural gas issues—briefly—which will be before the next Congress are:

► **Fair trade bill**—It was killed this year by the House Rules Committee, with some segments of the oil industry getting excited on opposite sides of the fence. Independent jobbers were strongly opposed to it. Some large companies (including Atlantic and Jersey Standard) were for it. Other companies didn't seem to care. It will be revived in 1961.

► **National fuels policy**—Members of Congress from coal states are exerting strong pressure for a reworked federal policy decree designed to help the ailing coal industry.

► **Minimum wage**—Perennial legislation, getting to be more of a headache particularly for service stations, although the amount of the federal minimum affects other segments of the industry.

► **Oil imports**—Definitely subject to revision under a new Administration.

► **Pipe line divorcement** and tires, batteries and accessories divorcement—due for further Congressional study.

► **Leasing bills**—Several of them will be around for the new Congress to take up.

► **American flag tankers**—Legislation in the controversial area is possible in 1961.

► **Boggs bill on foreign investments**—Not expected to make it through Congress this time, but expected to be back again.

Pipe Line Industry reports on the voting records of potential candidates

PIPE LINE INDUSTRY research has compiled a box score on how potential presidential and vice presidential candidates of both major parties in Congress have voted on oil and natural gas issues since 1948.

Not all the candidates were in Congress then, but are included in the box score as their service on Capitol Hill started.

Two possible presidential candidates—although both deny they are such—have no congressional service or voting records:

Adlai Stevenson, ex-governor of Illinois, opposed state ownership of tidelands in the 1952 campaign and has never taken a public position on any other oil or gas issue.

Nelson Rockefeller, governor of New York, has stated that the percentage depletion provision "is one of the important factors in developing production in the United States and, therefore, is a great necessity for our nation."

Summarizing the past records of other potential candidates:

Lyndon Johnson, Senate majority leader, has consistently supported the oil and gas industry on all major roll calls throughout his Washington career.

Richard Nixon, vice president, whose services as a voting member of Congress was relatively brief, voted for state ownership of tidelands and for the natural gas bill, but missed some important votes by being absent.

Hubert Humphrey and Stuart Symington, senators from Minnesota and Missouri, have consistently opposed the legislative position of the oil and gas industry.

John Kennedy, senator from Massachusetts, also has been consistently opposed, except for one instance when he voted against cutting the depletion provision from 27½ to 15 percent. However, he favored a sliding scale depletion provision in another roll call the same day.

Among possible GOP vice presidential candidates, Senator Kenneth Keating and Senator Barry Goldwater are 180 degrees apart. Goldwater has supported the industry view; Keating has opposed it consistently. Attorney General William P. Rogers, a GOP vice presidential dark horse, has never voted on an oil and gas issue.

On the following pages, PIPE LINE INDUSTRY presents a box score on the voting records of seven potential presidential and vice presidential candidates, plus 30 senators who will be seeking reelection this year.

How Potential Presidential and Vice Presidential Candidates Voted on 15 Oil and Gas Issues

[1]*(Bold copy in color denotes votes in favor of at least one segment of the oil and gas industry)*

NIXON (R)

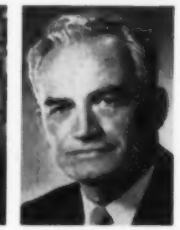
KENNEDY (D)

HUMPHREY (D)

SYMINGTON (D)

JOHNSON (D)

KEATING (R)


GOLDWATER (R)

Natural Gas Bill to free producers from FPC control, August 5, 1949. Passed by House 183-131.	For	[2]Against	*	*	*	Against	*
Reciprocal Trade Bill Amendment to establish oil import quotas, September 15, 1949. Senate rejected, 41-40.	*	*	Against	*	For	*	*
Kefauver Natural Gas Bill Amendment to exempt only those gas companies producing less than $250,000 worth of gas per year, March 29, 1950. Senate rejected, 58-25.	*	*	For	*	Against	*	*
Natural Gas Bill, final passage, March 29, 1950. Senate passed, 44-38.	*	*	Against	*	For	*	*
Senate version of Natural Gas Bill passed the House, 176-174, March 31, 1950. (Truman later vetoed Bill)	*	Against	*	*	*	Against	*
Holland Motion to kill Hill Amendment to Tidelands Bill which would earmark all oil revenue for federal aid to education, April 2, 1952. Senate adopted motion, 47-36.	For	*	Against	*	For	*	*
Tidelands Bill, final passage, April 2, 1952. Senate passed, 50-35.	For	*	Against	*	For	*	*
Douglas Amendment to Natural Gas Bill which would preserve FPC authority to make findings of fact on cost of intrastate pipe line facilities connected with interstate lines. July 5, 1952. Senate rejected, 52-21.	*	*	For	*	Against	*	*

cost of intrastate pipe line facilities connected with interstate lines. July 5, 1952. Senate rejected, 52-21.	*	*	For	*	Against	*	*
Tidelands Bill, final Senate passage, July 30, 1953. Senate passed, 45-43.	[3]For	Against	Against	Against	For	*	For
Natural Gas Pipe Line Bill prohibiting FPC from regulating utilities which transport natural gas within state boundaries if state certifies it exercises regulatory judgement. House passed by voice vote. Only recorded Senate vote was on Morse Amendment to kill bill by recommitting to committee, with negative vote being vote for bill itself, March 15, 1954. Senate rejected, 52-25.	*	For	*	For	Against	*	Against
Harris Natural Gas Bill, July 28, 1954. Passed House, 209-203.	*	*	*	*	*	Against	*
Harris-Fulbright Natural Gas Bill, February 6, 1956. Passed Senate, 53-38, but was later vetoed by President Eisenhower.	*	Against	Against	Against	For	*	For
Williams Amendment to an excise bill which would have reduced depletion provision from 27½% to 15%, August 11, 1958. Senate defeated, 63-26.	*	Against	For	For	Against	*	Against
Proxmire Amendment to same excise bill which would have instituted sliding scale depletion provision; 27½% on oil income up to $1 million; 21% between $1 million and $5 million; 15% over $5 million, August 11, 1958. Senate rejected, 58-31.	*	For	For	For	Against	*	Against
Douglas Amendment to another tax bill to institute sliding scale depletion provision, June 25, 1959. Senate rejected, 58-31.	*	*	[4]For	For	Against	[4]For	Against

*No voting record. [1]Rockefeller and Stevenson have no voting record on oil and gas issues, thus are not listed. [2]Absent, but announced against it. [3]Had become vice president but had announced in favor of bill. [4]Absent, but announced in favor of it.

How 30 Senators Seeking Re-election Voted on Five Oil and Gas Issues

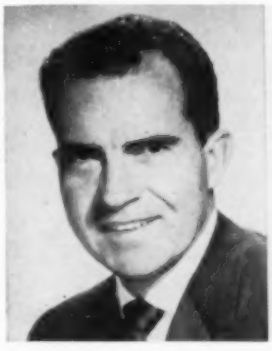
(Bold copy in color denotes votes in favor of the oil and gas industry)

	Kerr Bill to amend Natural Gas Act (March 29, 1950)	Harris Bill to amend Natural Gas Act (Feb. 6, 1956)	Williams Amendment to reduce depletion percentage from 27½ to 15% (Aug. 11, 1958)	Proxmire Amendment to reduce depletion percentage on graduated basis (Aug. 11, 1958)	Douglas Amendment to reduce depletion percentage on graduated basis (June 25, 1959)
Gordon Allott (D — Colorado)	*	For	Against	Against	Against
Clinton P. Anderson (D — N. Mex.)	For	For	Against	Against	Against
E. L. (Bob) Bartlett (D — Alaska)	*	*	*	*	Against
Styles Bridges (R — N. Hampshire)	For	For	Against	Against	Against
Clifford P. Case (R — N. Jersey)	*	Against	For	For	For
John S. Cooper (R — Kentucky)	*	*	Against	Against	Against
Carl T. Curtis (R — Nebraska)	*	For	Against	Against	Against
Paul H. Douglas (D — Illinois)	Against	Against	Against	For	For
Henry Dworshak (R — Idaho)	Against	For	Against	Against	*
James O. Eastland (D — Miss.)	For	For	Against	Against	Against
Allen J. Ellender (D — La.)	For	For	Against	Against	Against
J. Allen Frear, Jr. (R — Del.)	For	For	Against	Against	Against
Hubert H. Humphrey (D — Minn.)	Against	Against	For	For	For
Lyndon B. Johnson (D — Texas)	For	For	Against	Against	Against
B. Everett Jordan (D — N.C.)	*	*	Against	For	Against
Estes Kefauver (D — Tennessee)	Against	Against	*	*	For
Robert S. Kerr (D — Oklahoma)	For	For	Against	Against	Against
John L. McClellan (D — Arkansas)	For	For	Against	Against	Against
Pat McNamara (D — Michigan)	*	Against	For	For	*
Thomas E. Martin (R — Iowa)	*	For	Against	Against	Against
Karl E. Mundt (R — S. Dakota)	Against	For	Against	Against	Against
Joseph C. O'Mahoney (D — Wyo.)	Against	For	Against	For	*
Jennings Randolph (D — W. Va.)	*	*	*	*	Against
A. Willis Robertson (D — Va.)	For	Against	Against	Against	Against
Richard B. Russell (D — Ga.)	For	Against	*	*	Against
Leverett Saltonstall (R — Mass.)	Against	For	Against	Against	Against
Andrew F. Schoeppel (R — Kan.)	For	For	Against	Against	Against
Margaret Chase Smith (R — Me.)	Against	Against	For	For	For
John J. Sparkman (D — Alabama)	For	Against	Against	Against	Against
J. Strom Thurmond (D — S.C.)	*	For	Against	Against	Against

*Did not vote, or was not in office at the time.

Footnote: 33 Senate seats will be open in November. However Theodore F. Green (D—R.I.), Hall Stoner Lusk (D—Ore.), and James E. Murray (D—Mont.), are not seeking re-election.

Who will be the next President and Vice President?

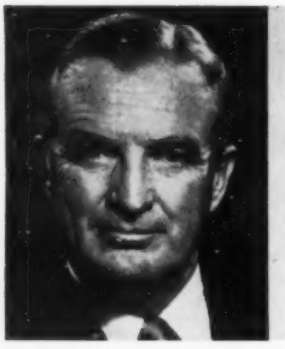


As Vice President in the Eisenhower Administration, the Californian has taken positions more liberal on some issues than when he served two terms in the House and two years in the Senate. Although he was absent on some key roll calls, his Congressional voting record was favorable to the oil and gas industry, including one vote for the natural gas bill. He hasn't had anything to say publicly about industry legislation since he became Vice President but is regarded by the industry as a friend. Born Yorba Linda, Calif., Jan. 9, 1913. Elected to the House, 1946; to the Senate, 1950; to the vice presidency, 1952.

Son of wealthy Joseph P. Kennedy, who has many close friends in the oil industry, the young Senator has been a foe of the natural gas bill and other major oil and gas issues. A cum laude graduate of Harvard, with subsequent study at the London School of Economics, he intended to be a writer and won the Pulitzer Prize for his book, "Profiles in Courage." But he turned to politics in 1946, running successfully for the House. The Boston legislator moved up to the Senate in 1952 with his spectacular defeat of Henry Cabot Lodge, Jr. Born May 29, 1917, in Brookline, Mass.

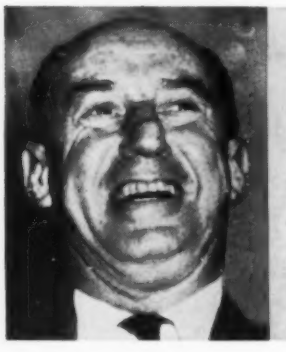
Democratic leader of the Senate since 1953, Lyndon Johnson has a 100-percent pro-oil, pro-natural gas voting record and has been ridiculed by syndicated columnists and liberal organizations for it. Over more than a score of years, he has been one of the most effective behind the scenes operators in behalf of oil and gas legislation. Born Aug. 27, 1908, in Johnson City, Texas, he received his B.S. degree from SW Texas State Teachers College, 1930; attended Georgetown Law School, 1935; LLD degree, Southwestern University, 1943. Came to the House in 1937 special election; won his Senate seat in 1948.

Immediately after his 1948 election, the Minnesota Senator earned a reputation as an outspoken left winger. He has quieted down some and has softened his views, but the first impression has remained for many. His voting record is decidedly anti-oil and anti-gas. He has withdrawn as a possible candidate for the Democratic Presidential nomination, but remains a potential Vice Presidential winner at the national convention. Born May 27, 1911, in Waverly, Minn., and was mayor of Minneapolis when elected to the Senate. He was re-elected to the Senate, Nov. 2, 1954.



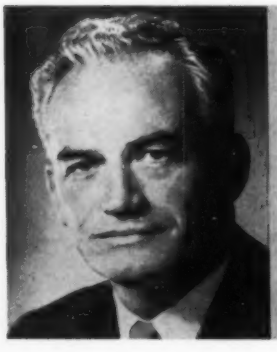
His Senate speeches deal almost exclusively with national defense, the subject on which he is best informed. Otherwise, Symington's voting record is consistently liberal, consistently against the oil and gas industry. A businessman, he identifies himself as the Presidential candidate who has met by far the most payrolls. But his voting record is rated higher by labor than by business. The Missourian held a number of high government posts before his 1950 Senate election; among them, Secretary of Air and chairman of the Reconstruction Finance Corp. Born June 26, 1901, in Amherst, Mass.

As a young man (from 1935 to 1939), Rockefeller worked for the Creole Petroleum Co., learning the oil business. He has devoted most of the rest of his time to public affairs, serving in a variety of positions with the Roosevelt, Truman and Eisenhower administrations. Oil men know him as a political friend of the industry, although his only public statement on an industry issue was a strong defense of the percentage depletion provision. Born July 8, 1908, in Bar Harbor, Me. Elected governor of New York (his first try for public office) in 1958 with a spectacular plurality of 573,034 votes.



Looming again as a possible Democratic Presidential nominee, Adlai Stevenson, the party's two-time loser has yet to make his views on industry issues clear. He opposed the law finally enacted quitclaiming title to the tidelands to the states. Little industry support or financial aid went his way in the two previous campaigns, but he retains a large following within his party, according to the polls. Born Feb. 5, 1900, in Los Angeles, he served one term as Illinois' governor, 1948-52, and has been practicing law in Chicago, traveling the globe and making speeches since.

A geographical match for Nixon in the Vice Presidential berth, New York Senator Kenneth B. Keating is in the liberal wing of his party and has cast all his votes against the oil and gas industry on the important roll calls. One of the best speakers, he is a humorist and among the most personally popular men in the Senate. Born May 18, 1900, in Lima, N.Y. Elected to the House in 1946; to the Senate in 1958.



The more conservative element within the GOP looks to Goldwater for leadership and would like to see him a candidate for Vice President, although this doesn't seem possible if Nixon is named to the top spot. Their states, Arizona and California, are adjacent. Solidly pro-oil and pro-gas on major roll calls. Born Jan. 1, 1909, in Phoenix, Ariz. Part owner of a retail clothing store in Phoenix.

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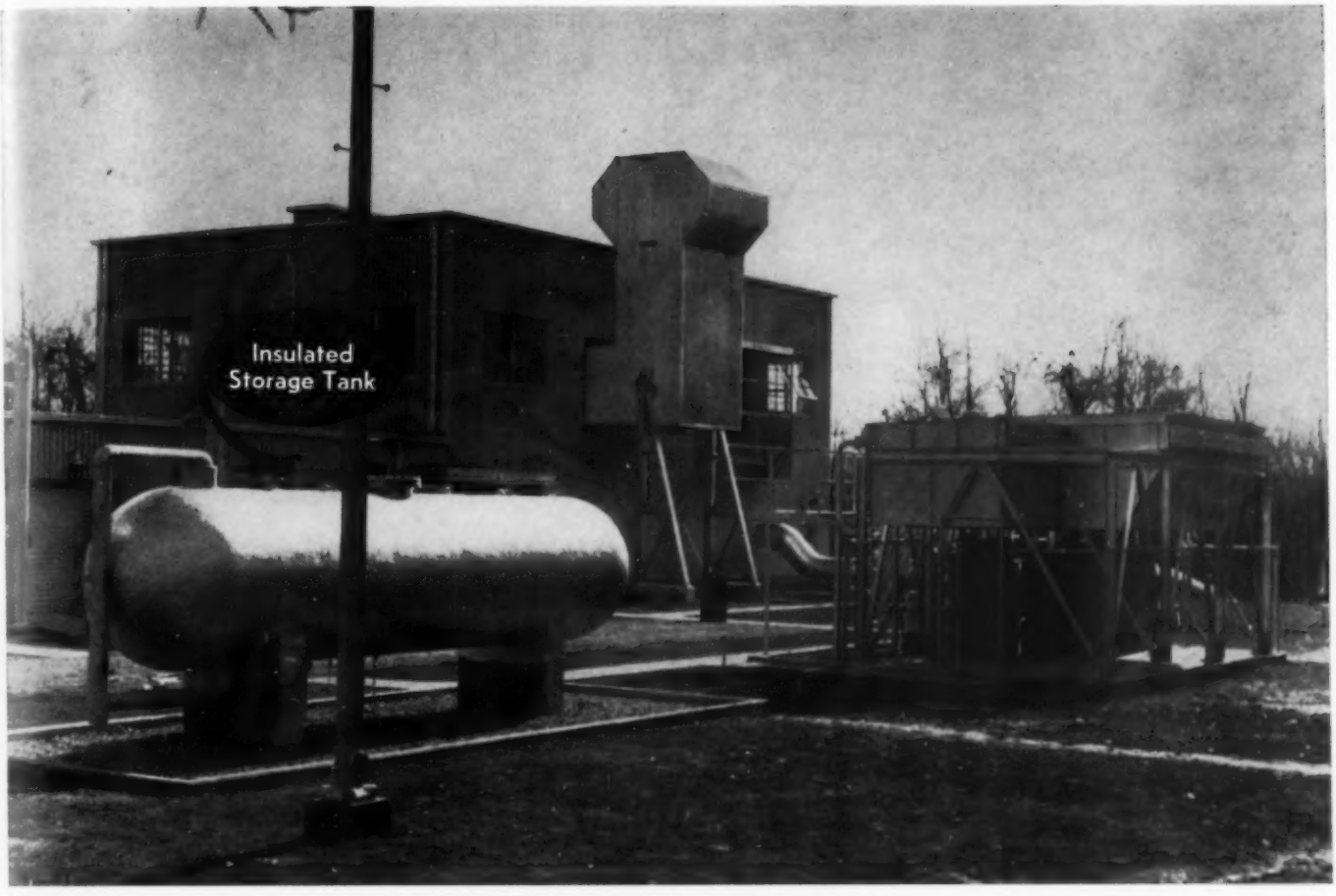


Gas turbine station uses fire-resistant lube oil which is stored in the insulated tank in foreground. When oil deliveries are made in mid-winter, auxiliary heat is necessary to prevent freeze-up.

PART 2

Synthetic Lube Reduces Fire Hazard at Turbine Stations

How to convert a station to fire-resistant lubrication system

By **O. M. Fletcher,** Assistant Supervisor
of Design and Construction
Texas Eastern Transmission Corp., Shreveport, La.

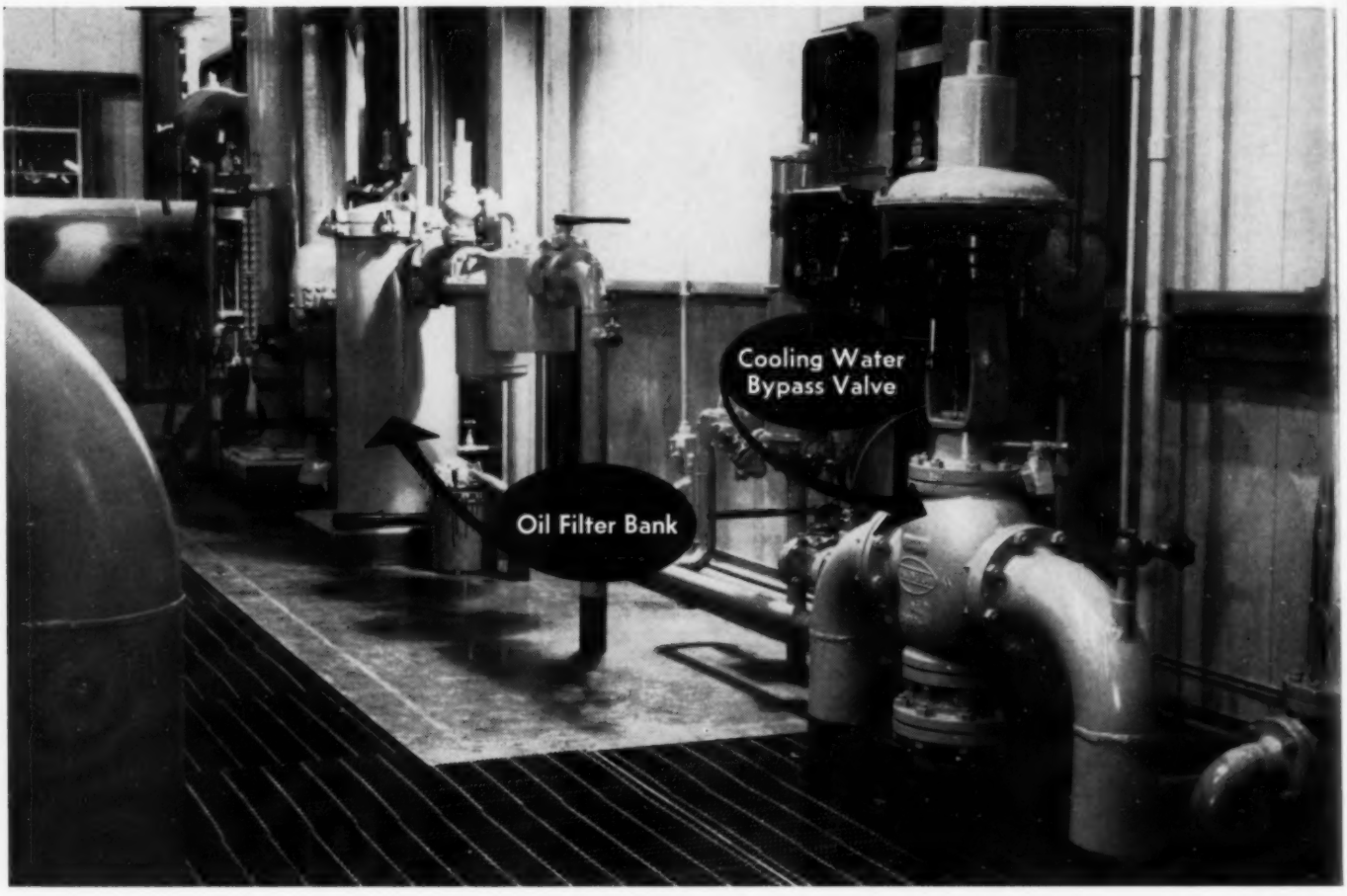
THE PREVIOUS PART of this article described many of the characteristics of the new synthetic, fire-resistant lubricants which Texas Eastern Transmission Corp. uses at gas-fired turbine stations. The primary advantage of the new lubricant is its ability to reduce fire hazard in case of equipment failure. Moreover, it makes it unnecessary to stop seal-oil pumps at the first equipment malfunction.

Part 1 also described the engineering aspects of implementing a synthetic lube-oil system.

ACTUAL STATION CONVERSION

Actual station conversion for use of the fire-resistant lube required far less time and effort than preceding engineering conversion work. Few problems arose that were not easily resolved on the site.

Cleaning Interior of Tanks. As has been expected, the major item was removal of the rust inhibited coating from the interior of the reservoirs. One of the paint removers, methylene chloride, while an excellent stripper leaving little residue, was eliminated as being too hazardous to personnel. Basically, preparations for tank stripping were concerned with keeping the caustic solu-



Interior of station showing oil filter bank and cooling water bypass valve for oil-to-water heat exchanger in foreground at right.

tion from all bearings, piping, pumps, control apparatus, etc. To accomplish this, auxiliary and emergency pumps were removed from tanks as were all control, regulating and relief valves. All internal piping and tank-connected external piping was blanked off. To assure liquid contact against top of the tank, a stand pipe was provided.

The tank reservoir was water filled, gradually adding the stripping compound at a rate of 10 ounces per gallon of water. Temperature of the solution was maintained between 120° and 140° F by use of a steam jet. The stripping solution was circulated at approximately 100 GPM from one end of the reservoir to the opposite end. After 18 hours, the solution was pumped out of the tank into underground disposal. Fresh water next was flushed through the tank until this flush water showed a pH below 8. Hand flushing as necessary, followed by a water pressure rinse, completed the stripping process.

Following the air drying of tanks, a coating of OS-81 was sprayed on all internal surfaces. The bare steel stripped surfaces were left with a silver brownish cast. Examination of tank interiors indicated the stripping procedure to have removed 85 percent of the undesired coating.

Preparation of station lube oil piping presented few problems. Proper thread compounds, gasket materials, etc., were applied. One item of note concerned the use of lubricated plug valves, wherein it was necessary to change the plug lubricants to one that was unaffected by the synthetic.

Hot oil flushing of the system was accomplished in the usual manner, using the synthetic oil at about 200° F. On completion of the flush, the oil was drawn off, settled and put through standard filters. A quality and appearance check confirmed that the flush oil was up to specification, whereupon the flush batch was returned to the reservoir as operating oil.

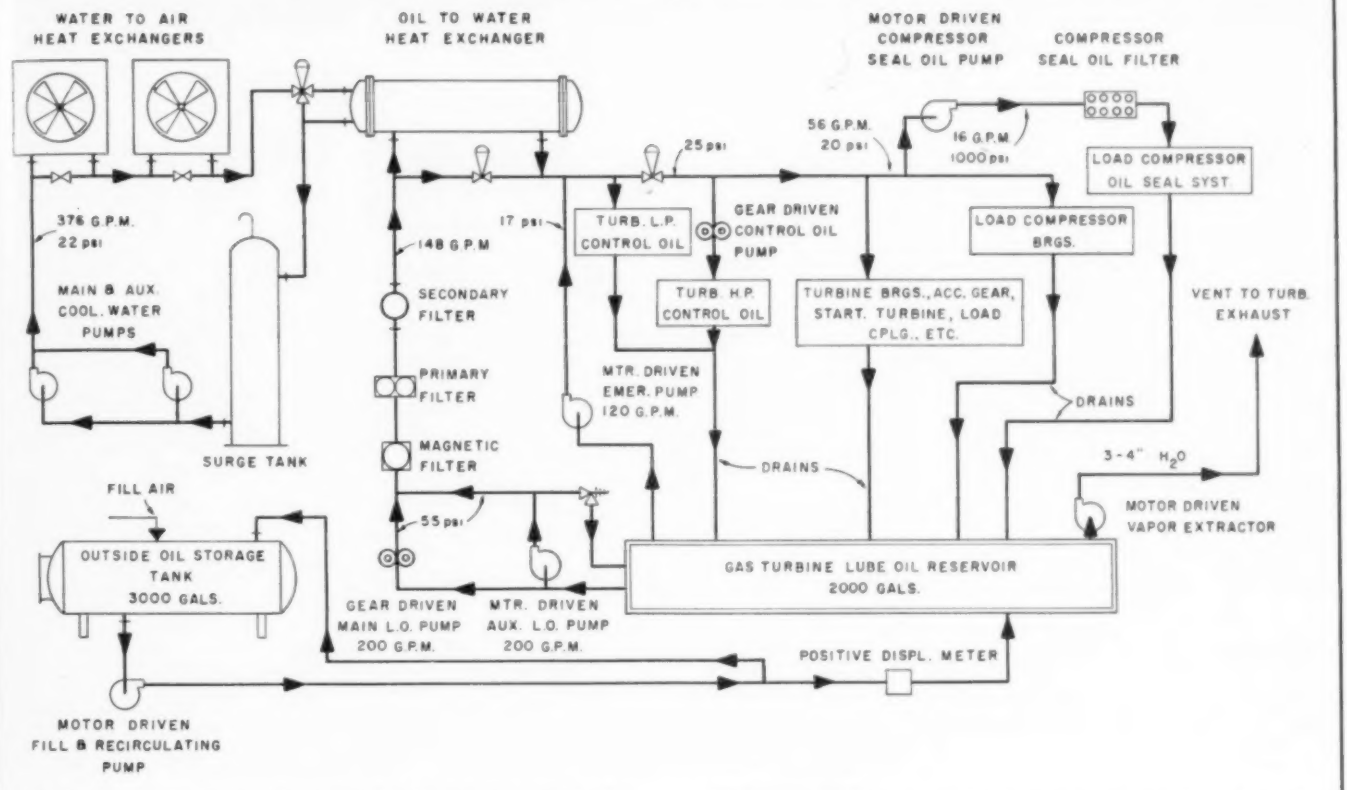
Replacement of certain turbine and compressor parts was accomplished in conjunction with each manufacturer's installation representative. Again no difficulties were encountered in actual machine conversion. Two items of known incompatibility with the oil were left in the turbine system. These were, neoprene bearing drain boots, which operate under conditions of low velocity and low volume flows. There is no pressure on the boots, likewise no relative movement. Therefore, it was felt these items would perform satisfactorily.

STARTUP OPERATIONS WITH FIRE-RESISTANT OILS

Initial start-up of a new unit is generally a time of anxiety over probable unknowns. In the case of the first of these units, this was certainly the situation. The turbine and gas compressor were the largest ever applied to pipe line operation and the compressor was a new design. The oil of course was a radical departure.

Observance During Start-Up. Considering the oil as an unknown element, certain functions were watched closely to observe the action of the fire-resistant lube oil in the system. For example, clear plastic cover plates were installed in the reservoir tops to spot any tendency of the oil to foam. Further, oil temperatures and pressures noted frequently; bearing temperature differentials and

DIAGRAM OF TYPICAL OIL SYSTEM FOR 13,400-HP TURBINE COMPRESSOR STATION


WATER TO AIR HEAT EXCHANGERS
OIL TO WATER HEAT EXCHANGER
MOTOR DRIVEN COMPRESSOR SEAL OIL PUMP
COMPRESSOR SEAL OIL FILTER
56 G.P.M. 20 psi
16 G.P.M. 1000 psi
25 psi
LOAD COMPRESSOR OIL SEAL SYST.
376 G.P.M. 22 psi
17 psi
148 G.P.M
TURB. L.P. CONTROL OIL
GEAR DRIVEN CONTROL OIL PUMP
LOAD COMPRESSOR BRGS.
MAIN & AUX. COOL. WATER PUMPS
SECONDARY FILTER
TURB. H.P. CONTROL OIL
TURBINE BRGS., ACC. GEAR, START. TURBINE, LOAD CPLG., ETC.
VENT TO TURB. EXHAUST
PRIMARY FILTER
MTR. DRIVEN EMER. PUMP 120 G.P.M.
DRAINS
SURGE TANK
MAGNETIC FILTER
DRAINS
3-4" H_2O
FILL AIR
55 psi
MOTOR DRIVEN VAPOR EXTRACTOR
OUTSIDE OIL STORAGE TANK 3000 GALS.
GAS TURBINE LUBE OIL RESERVOIR 2000 GALS.
GEAR DRIVEN MAIN L.O. PUMP 200 G.P.M.
MTR. DRIVEN AUX. L.O. PUMP 200 G.P.M.
POSITIVE DISPL. METER
MOTOR DRIVEN FILL & RECIRCULATING PUMP

Piping and vessels can be welded without any particular effort to clear them of vapor. One of the important advantages of the lubricant is that when used as a seal oil, it is not necessary to stop seal oil pumps at the first sign of turbine trouble.

vibration readings, for instance, on 2 to 3 minute intervals. Filter pressure drops were frequently checked for signs of filter clogging. The close observance, particularly of the first machine, certainly furnished some assurance that systems were operating within bounds.

Start-Up Problems. Start-up was not without incident. Problems of control malfunction, slight scoring of a major bearing, several worm gear failures, hot bearings, first one location then another, all occurred and each time blame was initially placed on the oil. Eventually other causes were established for the various incidents so by the time of third unit start-up the oil was no longer considered suspect.

In reviewing actual unit startups, it was found that the lube oil systems and its parts operated about as calculated. Oil foaming in the reservoirs was found to actually be less than normally experienced with petroleum oil. Filters had reacted normally, showing a 4 to 6 psi pressure drop with filter build up rates normal. Seal oil and control oil systems also functioned in a satisfactory manner, as did pumps, heat exchangers and related equipment.

As mentioned earlier, temperature rise across individual bearings was closely watched as an indication of bearing action on the synthetic. Unfortunately these turbines were never operated under load with petroleum oil; however, each was run without load by the manufacturer using 194 SSU @ 100° petroleum oil. This basic data is compared here against the averages of three stations.

Uncoupled Turbine Run (4860 RPM) Temperature Rise Across Bearings

	No. 1 Bearing	No. 2 Bearing	Thrust Bearing
3 Station Average (Oil—OS-81)	26° F	27° F	42° F
Factory Test (Oil—Pet.)	20° F	18° F	30° F

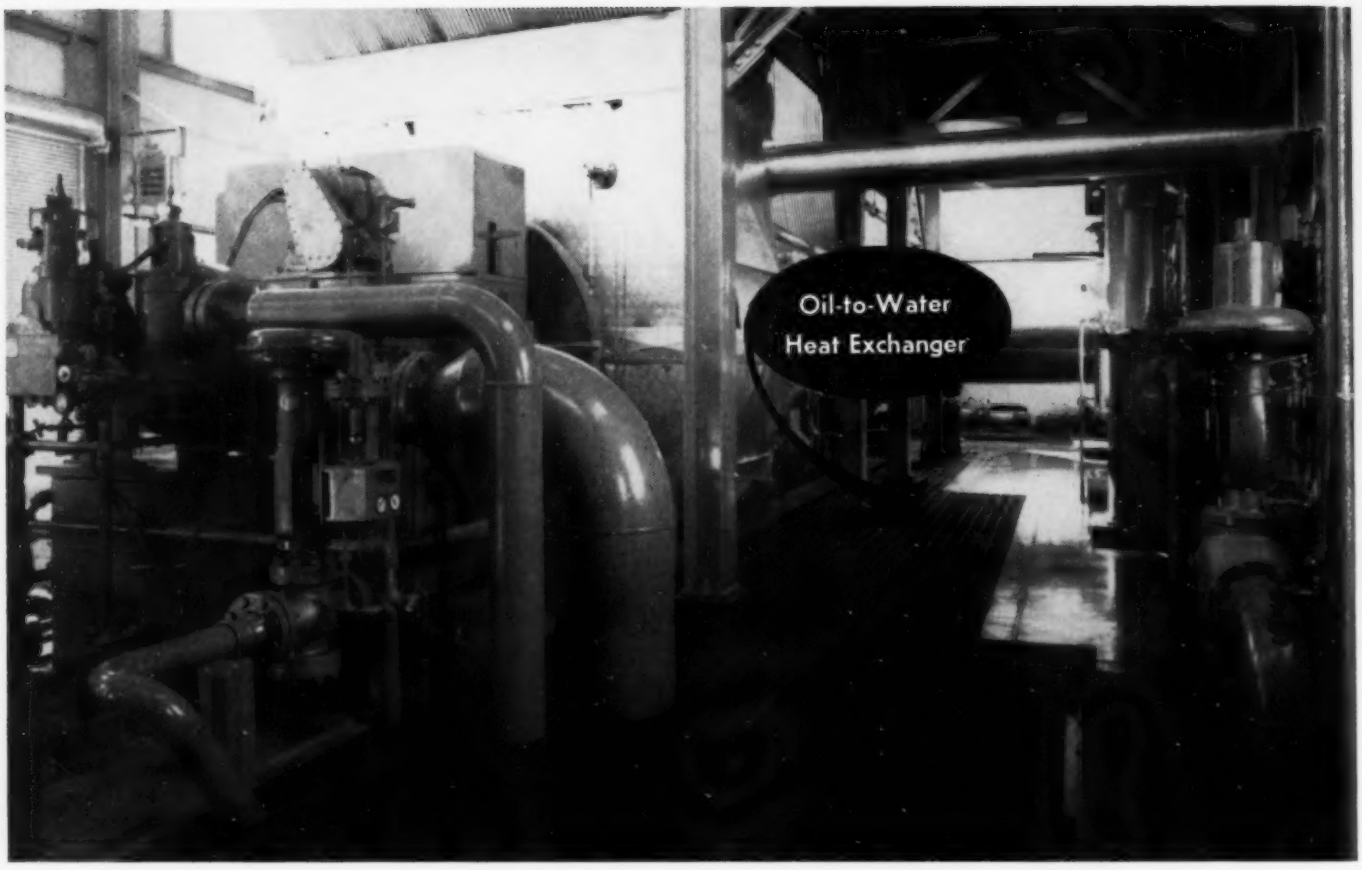
This represents a 6 to 12° F temperature differential rise on the synthetic lube. Similar factory compressor test represented a 4 to 6° F rise.

Because of varying conditions, the units have not been operated continuously at maximum horsepower; however, during each start-up units were run to rated speed at power factors up to 88 percent. Bearing temperature data from these runs, in condensed form below, is compared to bearing operation on an identical machine using 150 SSU @ 100° F petroleum oil.

Loaded Turbine Run (4860 RPM) Temperature Rise Across Bearings

	No. 1 Bearing	No. 2 Bearing	Thrust Bearing
Station 73	21° F	30° F	36° F
Station 71	28° F	41° F	46° F
Station 70	25° F	36° F	38° F
Station 72	27° F	41° F	46° F
Average for Synthetic	25° F	37° F	42° F
Identical Unit Oil—Pet.)	28° F	35° F	35° F

This represents a possible 2° to 7° F temperature dif-



Oil-to-water heat exchanger is located in pipe trench under grating alongside the turbine.

ferential rise on the synthetic, ignoring the possibility of tight individual bearings.

The temperature rise across the bearings of the loaded gas compressor generally paralleled those of the turbine.

During centrifugal compressor station initial operations, a certain amount of seal oil is normally lost during adjustment functions. These stations were no exception. Such seal system malfunctions resulted in several hundred gallons of oil mist being deposited over station sites. Improper "O" ring material was responsible for two such occurrences.

Quality of the synthetic oil was checked carefully twice per week during start-up operations to assure that the oil was remaining on specification. These checks disclosed the oil to remaining completely stable. It was generally considered that the fire-resistant oil had "come of age" with apparently successful operation of the final station.

UNUSUAL ASPECTS OF FIRE-RESISTANT LUBE OPERATION

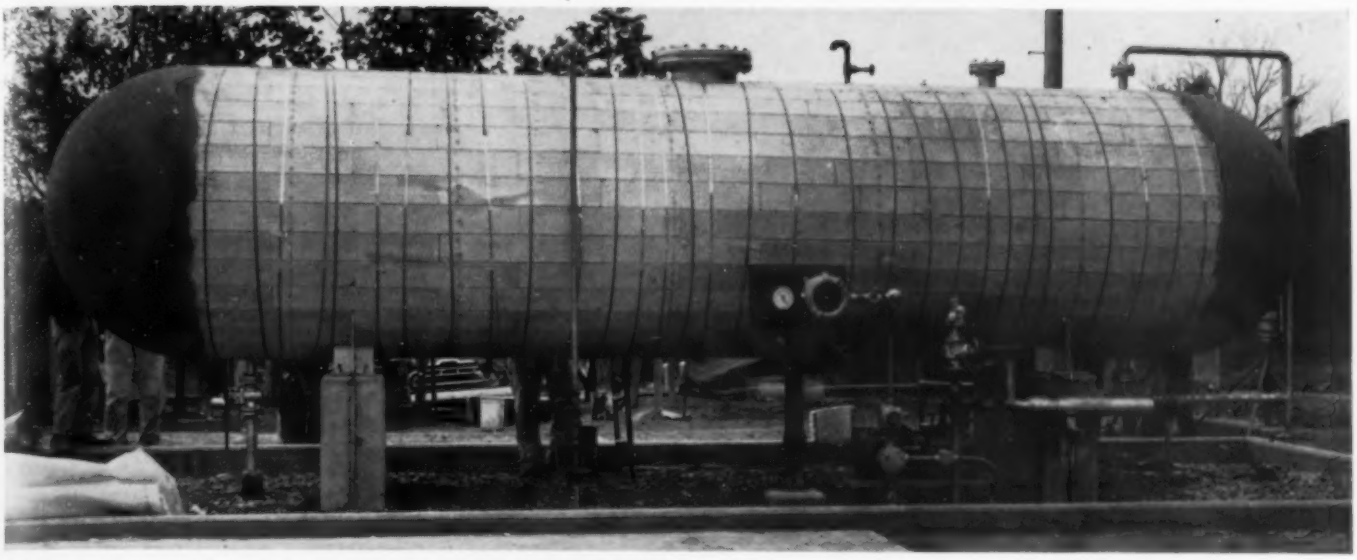
Years of operation with petroleum lubricants have conditioned thinking along definite lines. Some of these concepts need revision when operating with a fire-resistant lubricant.

Toxicity. Several months operation by the four stations has disclosed some unusual aspects of fire-resistant lube usage. First, there is the question of toxicity. This oil is considered non-toxic; however, there there were several cases of minor eye irritations resulting from negligence. Hot oil vapors or liquid, when in contact with the eyes, will cause eye irritation. With treatment, these eye irritations completely disappear in about 24 hours. General skin susceptibility varies with the individual. Some are completely unaffected, others must use gloves or a protective cream such as standard MSA silicone hand cream. Most personnel now find soap and water the only treatment necessary after working with the liquid. At worst, toxicity is a minor nuisance.

Oil Appearance. An interesting point developed around a change in oil appearance immediately after going into service. As received, the oil is water white and opaque; however, with service it becomes clear. This was resolved quite easily, being merely a case of an additive plating out onto metal parts.

Dye Gives Color. A clear, water-like liquid sloshing in the tanks and draining through sight glasses is at first somewhat disconcerting. Not only is it disconcerting, but it becomes rather difficult to judge gage levels and sight glass flows. Coloration of the oil would be the answer, but, to avoid the possibility of mixing petroleum and synthetic oils, the synthetic would have to be a distinctive color. A Sudan Red #4BA dye in percentage of 25 to 50 PPM, has now given quite satisfactory coloration. The dyed oil now has the general appearance of "red cough syrup."

Leak Detection. Color, along with paint incompatibility, has shown a definite advantage in tracing miscellaneous



Synthetic lube oil storage tank under construction at Bernville, Pa.

oil leaks. Both items aid mutually, for either shows a positive trail to the actual leak. The end result is less leakage, for a blistered paint trail colored red is difficult to overlook.

Effects of Cold Weather. Bulk oil delivery operations become quite unique in severe cold weather of 10° or lower. Oil deliveries in such weather have to be made by tank wagons having heating coils, otherwise a glass-like mass results. Quality of the oil is unaffected by the change of state; however, delivery would have to be by pick and shovel.

Burning and Welding. A most radical departure from usual oil procedures became apparent when minor changes were proposed in the tank internal main oil header. These changes required cutting of the oil line, welding in of flanges and a valve insertion along with relocation of pipe supports. All work was accomplished easily and safely by lowering the reservoir oil level and actually working in the tanks. Removal of smoke and fumes from the tanks was the only item requiring any special attention. To accomplish such a job on a petroleum oil tank is a dangerous procedure requiring special precautionary measures.

The idea of compatible and incompatible parts certainly brings to mind possible operational and maintenance problems. As had been expected, an occasional Neoprene or Buna N "O" ring or diaphragm was overlooked during conversion; however, system malfunction occurred only when these applications were dynamic. If they were in static locations there was no problem until the item was removed, then it quite suddenly increased in size. The general appearance of suitable and unsuitable materials can be quite similar, therefore proper identification of replacement parts is essential. Any parts of doubtful composition should be checked by exposing samples to the synthetic oil for a few hours.

Quality Control. As with petroleum type lubes, the fire-resistant oil is periodically analyzed for the status of its physical qualities. The scope of synthetic oil quality control analysis is very similar to that of regular oils, covering **Viscosity, Specific Gravity, Acidity** and **Water Content.** One point of note concerns contamination of the synthetic with petroleum oil. With viscosities of the two being identical, the only qualities altered in the synthetic are a lowering of special gravity and a drop in fire resistance. Considering fire resistance the prime reason for usage of the synthetic, petroleum contamination must be avoided.

PERFORMANCE RECORD

The operating log of each individual station now shows over 2,500 service hours all of which have been accumulated while operating on fire-resistant synthetic lube oils.

Briefly, in review, the conversion of these stations was not particularly complicated for once the scope of the problem was known, it was mostly a matter of procedure and materials. Start-up operation, while not without the usual incidents, had gone satisfactorily. In continued operation the machines and oil systems have functioned in a normal manner. There are no machine difficulties which have been attributed solely to the use of the synthetic oil.

Oil stability has been excellent, remaining easily within close quality specifications. Oil consumption due to falling off specifications therefore certainly seems to present no problem.

Coupling guard leakage at one station provided a practical test of oil fire resistance by causing oil to be sprayed against a 700° exhaust housing. Burning and welding of oil piping within oil tanks further demonstrated fire resistance.

Over-all, fire-resistant oil operation thus far has been satisfactory enough to warrant serious consideration of conversion plans for all remaining gas turbine compressor stations. In short a good fire-resistant oil can perform well as a lubricant while greatly reducing the fire hazards inherent in the use of petroleum oils at turbine stations.

—The End

30-Inch Line Pulled 14 Miles Under Caribbean from Isle of Margarita

LAUNCHWAY AND CONTROL TOWER on the Isle of Margarita off northern Venezuelan shore. The 30-inch line was pulled toward the mainland in 2,400-foot sections. Engineers in the tower kept an up-to-the-minute plot on the pipe's position and progress as it moved shoreward.

FOR FRESH WATER, the 70,000 inhabitants of the Isle of Margarita in the Caribbean Sea off the northern shore of Venezuela once depended on barge shipments from the mainland. But this 50-mile water haul began to prove impractical and inadequate as the island population grew and a stream of vacationers multiplied. The Institute Nacional de Obras Sanitarias of Venezuela explored the feasibility of laying an underwater pipe line to connect with the mainland and commissioned the engineering firm of Daniel, Mann, Johnson and Mendenhal de Venezuela to conduct an intensive hydrographic survey.

As a result, plans were completed for a 14½-mile, 30-inch line to run from the mainland to Margarita. The contract for its construction was awarded to Construcciones Collins de Venezuela, C.A., the DeLong Corp. and Technica Constructora, C.A., as a joint venture project. Work got under way in May 1959.

The line was designed for a 100-year life. It was coated inside and out with concrete and all welds—including factory-made longitudinal ones—were X-rayed.

At the launching area on Margarita, each joint of pipe was shot-blasted, primed and coated with two wraps of fiber glass, 7/32-inch of pipe line enamel and a single wrap of felt. The external concrete coating was cast on the pipe and the joints were welded into 2,400-foot sections for launching under the sea.

As they were completed, each section was pigged and pressured to 150 psi with air so the welds could be soap tested. In addition the girth welds were X-rayed using a crawler type machine. After the weld areas were field-coated the 2,400-foot sections were coated with an internal mortar lining.

Preparation of the Route. Jet probe tests were made of the bottom material along the route, and where

rock was encountered it was drilled and blasted. Following blasting and cleanout, the ditch was padded with soft material to protect the line.

The first step in making the offshore pull was to lay anchor cables along the centerline of the pipe line route for the winch barge. Two anchor cables were unspooled from a winch barge over the 14½-mile distance, carried ashore on the mainland and clamped to a heavy anchor block imbedded in the earth. This assembly was designed to withstand a 750,000-pound pull—more than twice the estimated pull required to snake the line from the island to shore.

How the Line Was Pulled. The winch barge was anchored offshore from Margarita and dual 2-inch cables were carried ashore and attached to the buoyant pulling block. The barge was snubbed off against the two anchor cables as it began its first pull. As the 2-inch cables were reeled up by the twin drums on the large winch, the heavy concrete coated pipe inched into the water. After a 2,400-foot section had been launched, the barge moved ahead 2,400 feet pulling against the anchor lines (which were spooled onto reels and transported ashore in sections) and paying out on the 2-inch pull cables.

Meanwhile, a second 2,400-foot section was welded onto the first, and after proper inspection and coating, it too was pulled into the sea. For 17 days and nights, this operation continued until the 14½-mile line came ashore on the mainland.

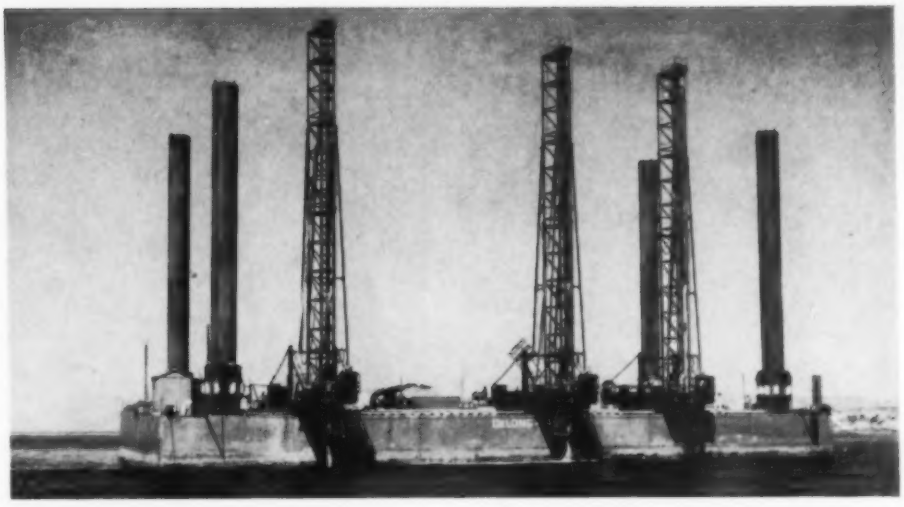
In order to pull the last section, a canal was cut into the mainland so the pull barge could winch the pipe close enough to shore to allow land crews to take charge. Upon completion of the last pull, the pulling barge was moved out of the flotation ditch, the ditch was dammed and water pumped out to make the end of the line accessible to land crews.

Upon completion of this line, a seven mile 8-inch line was laid from Coche island to the mainland using the same methods and equipment. Both of these lines were buried by trenching.

Completion of the two lines is the realization of a dream for many of the islanders. It will transform the islands into prosperous agricultural areas and more desirable vacation spots.

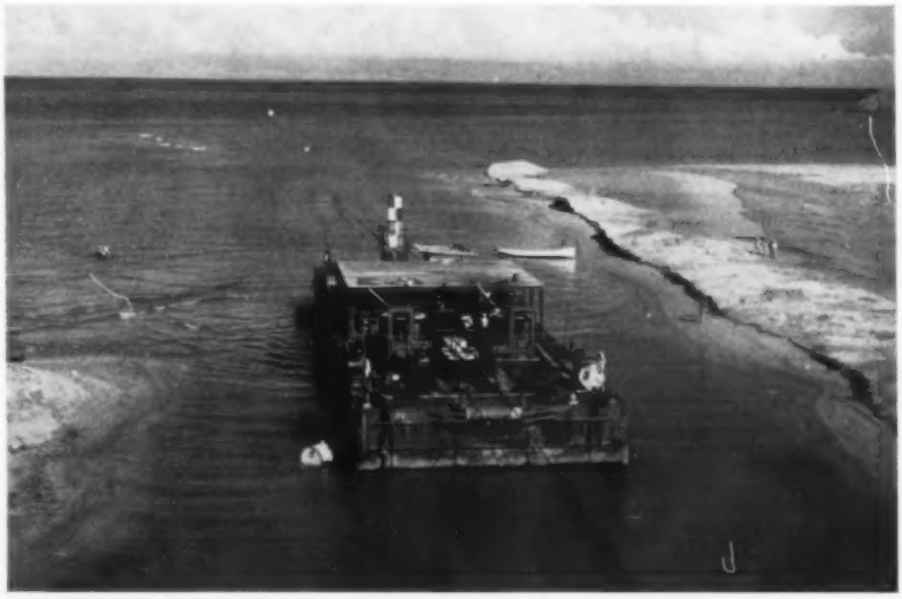
ACKNOWLEDGMENT

Photos by Collins Construction Company.



DeLONG DRILL BARGE was used for drilling and blasting the sea bed in rock and coral areas along the route. Three air-operated drills mounted independently sped the work.

CRAWLER-TYPE X-RAY MACHINE was used to X-ray longitudinal seams on each joint of pipe as it was received at the job site. The line was designed to last 100 years.



COLLINS PULL BARGE is shown here in the flotation canal cut on the Venezuelan mainland. This allowed the barge to pull the pipe into shore. Afterwards, the barge was floated out, the ditch dammed off and water pumped out so pipeliners could tie in the line.

FIGURE 1

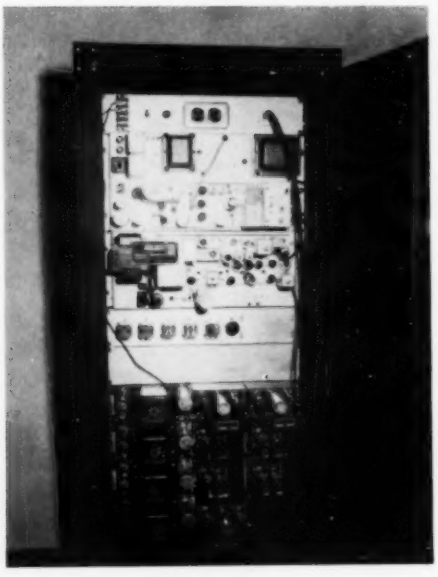


FIGURE 2

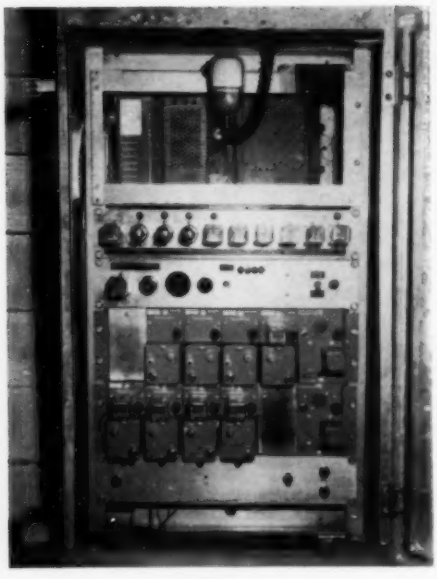


FIGURE 3

Left is a front view of the shore-based control station that costs only $2,500, not including tower. The unit uses 7½ Kc, 170 Mc channels in the newly available industrial development frequencies. This unit is located at Grand Isle, La. Center is interior view of the control station. Lower panels are four racks of audio tone equipment with two dual transmitters, one dual receiver and a single receiver. Above the tone equipment are storage relays. Station receiver and transmitter are at top. Figure 3 is interior view of the offshore platform station. This battery-powered unit requires very little power, because it is transistorized except for three tubes in the final of the RF transmitter. Power for the transmitter-receiver comes from 40-cell bank of air-depolarized dry primary batteries producing 12 volts; power for the 24-volt relay and tone equipment comes from 20-cell bank of dry batteries connected in series. Normal current requirements are only 0.77 watts. During transmission, 175 watts are required, but current drain on batteries is low because transmissions last only two minutes and they are pulsed 30 times per second.

Humble's Low-Cost Radio Alarm and Control System

Grand Isle system uses 7½ Kc, 170 Mc channels, costs only $2,500 per control station, batteries in offshore stations have 3 to 5 years capacity

By G. G. Van Burkleo and L. A. M. Barnette
Humble Oil & Refining Company, Houston

USING THE NEWLY available *industrial developmental frequencies* in the VHF band, Humble Oil & Refining Co. came up with a low-cost multichannel radio alarm and control system that holds much promise. The system uses audio tones for frequency division multiplex, and it is highly conservative of spectrum space—from both the standpoint of time and frequency. It features battery-operated remote stations with extremely low power requirements.

Equipment for the two-way, three channel, simplex operation costs about $2,500 for each control and remote station not including towers for antenna elevation.

History. As long ago as 1947, Humble was trying to outguess the trend in radio frequency usage. The company had planned a combined gas flow telemetering and supervisory control installation which would use radio as the transmission medium. But, at the time there were no specific frequency allocations for such use and the company successively made applications for authorizations in the 150, 220, and 450 Mc bands. When a license was finally obtained it was for a 960 Mc frequency and the gas field was nearly depleted so there was no

longer a need for the telemetering service.

Through the years work has continuously been directed toward providing more communication in fewer Kc's of spectrum space as an aid to fulfilling company and industry needs. Humble was one of the instigators and hosts to the now famous narrow-band radio tests demonstrated by the equipment manufacturers in 1951, that resulted in FCC Rule changes so industry now has "split channels." Industrial use of *single side band* has not ceased to be in perspective; however, early development on system design was deferred, at least in part, in the hope that a better solution for oil field communications would be obtained economically.

Alarm and Control System Using 7½-Kc—170-Mc Channels. The advantages of instantaneous or high speed remote control in dispersed operations are obvious. What is not so obvious, at times, is a way to justify such systems economically. In the past this problem has been compounded by the fact that there has been no middle ground between full-fledged microwave systems and no system at all. Some help along this line for industrial users was recently volunteered when the Federal Communications Commission created two 5-Kc and three 7½-Kc Development channels in the VHF band. How long this small allocation will last under the pressure of mobile requirements remains to be seen. Nevertheless, Humble has secured a license, obtained equipment, and is now engaged in a program of development along this line.

These newly available channels are bands of frequencies rather than specific frequencies, and they are available only under the terms of a Developmental grant. As listed in paragraph 11.46 (j) of the FCC Rules and Regulations, they are:

154.4600—154.4675 Mc	7½ Kc
173.2000—173.2075 Mc	7½ Kc
173.2075—173.2125 Mc	5 Kc
173.3875—173.3925 Mc	5 Kc
173.3925—173.4000 Mc	7½ Kc

This paragraph also states that the sum of the bandwidth occupied by the modulation and that required by frequency tolerance cannot exceed the limits of the frequency bands indicated. Presumably then, it is permissible to operate single side band on these channels if one is so inclined and properly licensed.

The 150-Mc channel is part of a 60-Kc band separating Public Safety and Industrial Radio Services (See Figure 4). Specifically, it lies on the industrial side between 154.430 Mc allocated to Fire Radio Service and 154.490 Mc allocated to Special Industrial Radio Service.

New Channels. The four 170-Mc channels are situated in the spectrum, two each, at the upper and lower ends of four 50-Kc channels allocated to Motion Picture Radio Service and Relay Press Radio Service (see Figure 5). In 1958, the four 50-Kc channels were split and three new 25-Kc channels were created. Four *sliver* channels were also created at this time. The three new 25-Kc channels were allocated to the Power Radio Service, except for the states of Texas, Oklahoma, Louisiana, Arkansas, Washington and Oregon, where they were allocated jointly to Petroleum and Forest Products Radio Services. The *sliver* channels were allocated to all industrial users. The upper two *sliver* channels are 600 Kc below the lower edge of TV Channel 7 (174.000 Mc), and the lower to *sliver* channels are 800 Kc below Channel 7. Down spectrumwise, it is 825 Kc from the lower *sliver* pair to the next non-government channel at 172.375 Mc allocated to Public Safety.

Although specific allocations have been made to non-governmental services in the band of frequencies from 162 to 174 Mc, that entire band is also allocated to government service. All things considered, the lower of the two 7½-Kc 170-Mc channels was chosen as best suited for Humble's needs.

Humble's system then operates on a center frequency of 173.20375 Mc ±866 cycles with a peak modulation of ±1.8 Kc. The highest modulating tone in normal operation is 1,075 cps which fixes the minimum modulation index at 1.67 for a deviation of ± 1.8 Kc. It will be recognized that this is approximately the same minimum modulation index figure of a voice circuit when ±5-Kc deviation is employed.

Technically, this system may be described as non-continuous, single-carrier operation with frequency division multiplex using audio tones. There are four tone-channels in service from the control to the remote station and three channels from the remote back to the control station. This number of channels appears adequate for present needs. When, and if, expansion becomes desirable, additional audio tones can be added or, what is more likely, a combination system using both time division and frequency division multiplex can be employed.

Physically, the system consists of one 30-watt 117-volt ac operated station installed on shore at Humble's Grand Isle District office and one 30-watt battery-operated remote station installed offshore on an oil well production platform in the Gulf of Mexico.

Description of the Equipment. Figure 1 shows a view of the front panel of the shore station. The row of lights and buttons on the left-hand side of the lower panel pertain to Platform A where the remote station is installed. When additional remote stations are installed on other platforms, similar columns of lights and buttons will be added to this panel. The top button in this column keys the transmitter and the address tone-generator. The second button resets the lamps below. The two lamps immediately below this button indicate an alarm condition at the remote station. The upper of the two which is green, flashes when the alarm is being received. The lower of the two which is red, lights in synchronism with the first flash of the green lamp. It then burns continuously until reset.

The lower two lamps pertain to a confirmation signal that a requested supervisory function has occurred. When this report is being received, these lamps respond similarly to the alarm lamps. When either an alarm signal or an off-confirmation signal is being received, a bell or buzzer sounds in synchronism with the flashing green light. Whether the bell rings or whether the buzzer rings depends upon the position of the toggle switch located immediately above on the lower part of the top panel.

The three black buttons and the toggle-switch protected by a red flap on the lower part of the top panel pertain to various functions that may be requested of the remote station by an operator at the shore station. These include from left to

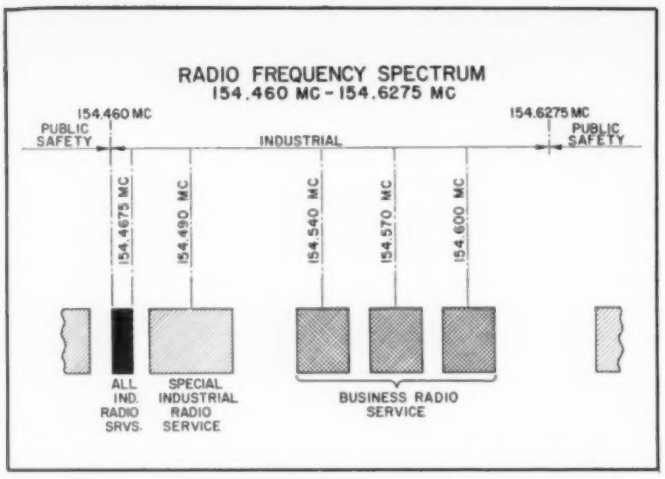


FIGURE 4—Newly available channels in the radio frequency spectrum (shown in dark) lies between Public Safety and Industrial Radio Services.

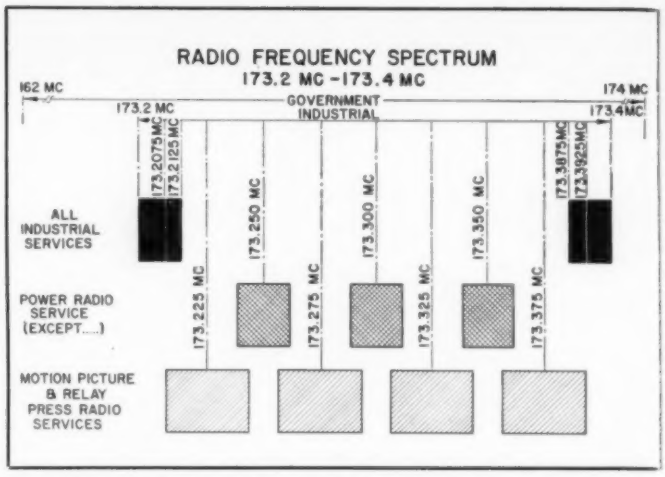


FIGURE 5—Four newly available channels in the 170 Mc range (shown in dark). Two each are at the upper and lower ends of four 50 Kc channels allocated to Motion Pictures Radio Service and Relay Press Radio Service.

right: (1) System Test, (2) Stop Test, (3) Remote Station Reset and (4) Supervisory function under the red flap.

A spring-loaded toggle-switch under a spring-loaded flap was used for the supervisory function instead of a pushbutton to reduce the possibility of accidental actuation. The meter is in the first limiter of the station receiver and is indicative of receiver signal strength. A downward trend in the average day-to-day readings of this meter will indicate deterioration of equipment performance and help prevent unscheduled outages. The three small lamps below this meter are the customary power and RF energy indicators. The handset is used for voice communication during equipment repair. A speaker and volume control are located in the upper left corner of the top panel.

Figure 2 shows a view of the interior of the shore or control station. The lower, dark-colored panels are four racks of audio tone equipment consisting of two dual transmitter units, one dual receiver unit and one single receiver unit. On the second panel above the tone equipment are located the storage relays for the indicator lights. Above this panel is the station receiver and above that the station transmitter. This is conventional tube-type equipment and operates from 117 volts ac.

Figure 3 is a view of the interior of the platform or remote station. The two lower, dark-colored racks contain the audio tone equipment which consists of four tone transmitters, three tone receivers and one relay driver. On the two racks above are relays controlling the automatic sequencing unit, automatic fault sensing units, automatic lock-out units, local reset button and microphone disabling switch. Above these two panels is the transmitter receiver unit. This equipment is mounted on a standard 19-inch rack and the rack itself is hinged at the bottom to allow lowering for repair purposes. To enhance accessibility even further, the transmitter-receiver unit is hinged to the rack and may be swung out by removing two rack screws on the right-hand side.

Power Requirements. This equipment is fully transistorized except for three tubes in the final of the RF transmitter. The transmitter-receiver operates from 12 volts DC, and the relays and tone equipment operate from 24 volts DC. Power is supplied to the transmitter-receiver from a 40-cell bank of air-depolarized dry primary batteries connected into four parallel strings with 10 cells per string. Power to the 24-volt equipment is supplied by a 20-cell bank of air-depolarized dry primary batteries connected in series.

In stand-by operation, none of this equipment is energized except the RF receiver and the tone receiver corresponding to the platform address. The battery drain under these conditions is 40 milliamperes from the 12-volt system and 12 milliamperes from the 24-volt system.

This represents an energy expenditure of only 0.48 watts and 0.29 watts, respectively, or a total of 0.77 watts. During transmissions, the power input increases to approximately 175 watts; however, since transmissions are of very short duration (two minutes) and are pulsed 30 times per minute with an off-characteristic of 0.6, the average power input is quite low. With 15 transmissions per day, the 12-volt bank has a 3-year capacity and the 24-volt bank has a 5-year capacity.

The size of these banks of batteries were dictated by current withdrawal and voltage requirements rather than any desire to avoid early replacement. As a matter of fact, for reasons other than exhaustion of capacity, it is not expected that these banks will last more than two years. Smaller banks can be employed by using a lower power transmitter, a primary-secondary battery system, or by mixing battery sizes. Each method, however, represents some sort of compromise.

How the Stations Operate. In operation, both stations are normally passive except for the station receivers. When an alarm occurs at the remote station, power is applied to an audio tone generator corresponding to the alarm monitoring point, an audio-tone generator identifying the platform, and time-delay relays that energize the transmitter filaments, pulse the transmitter keying circuit, and lock out the fault sensing relay at the end of the transmission. This entire sequence requires about two minutes. At the end of that time, the

fault is locked out and the remote station returns to a passive condition. Pulsing of the transmission allows other remote stations to capture the shore station receiver and report simultaneous alarms from other platforms. The shore station receiver decodes the transmission by recognition of the discrete audio tones and energizes appropriate lights to identify the function and the platform.

To perform a supervisory function, the reverse procedure is employed. Two audio tones, corresponding to the platform address and the supervisory function, are modulated on the RF carrier. These tones are recovered by the remote station installed on the platform addressed. Other platforms do not respond to this signal because each has a discrete audio-tone address. Unless this address tone is received, a remote station's other tone receivers are not even energized. Consequently, before any operation can be performed at a remote station, two audio tones must be received: (1) the address tone for that station and (2) the tone of the function requested. The remote station responds as long as the operator at the control station transmits the command signals. When this transmission ceases, the remote station returns to a passive condition.

Confirmation. To confirm that a requested supervisory function has occurred, a monitoring switch senses the change in position of the valve or other equipment actuated and this information is reported to the shore station in exactly the same manner as an alarm is reported, except a different audio tone is used to identify the function reporting. In Humble's system this is referred to as off-confirmation.

Testing. A test of the electronic equipment to determine proper operation may be initiated by the shore station operator. Over a discrete tone channel, a relay in the remote station is closed to simulate fault conditions at all monitoring points. The remote station then reports this information to the shore station. If it is correctly displayed, operation is normal; if not, the need for corrective maintenance is indicated.

In testing a large number of remote stations in this manner, it is inconvenient to wait a full 2½ minutes for the remote station to complete its report. To avoid this inconvenience, the operator may reset the remote station by transmitting a reset function command in the interval between remote station transmission pulses. This command resets the relay simulating the faults and the test is terminated. The remote station then return to a passive condition. This reset feature is also used to reconfirm alarm reports or off-confirmation reports from the remote station. Therefore, an operator arriving at the shore station and seeing an alarm light lit for a particular platform may reconfirm that an alarm has occurred at that point by addressing a reset command function to that remote station. If the alarm condition still exists, it will again be reported to the shore station. If it has cleared in the interim, an alarm condition at that point will not be reported.

Special requirements connected with the filing of applications for developmental operations may be found in Subpart E of Part 11. It appears, however, that the Commission would actually like to have more information than is asked for in this part of the Rules. Humble's next application of this sort will include:

- A description by make and model number of all transmitters to be used under the authorization, even though they may be type accepted for service under Part 11 (if the transmitters are not type accepted for service under Part 11, a complete technical description will be submitted).
- Equipment with a frequency tolerance equivalent or better than that set forth in 11.102 shall be selected and that technical parameter will be stated in the application.
- Rated power output of the individual transmitters will also be stated.
- The proposed method of operation will be set forth in considerable detail, including statements to the effect that continuous carrier operation will not be employed, and in fact considerable effort will be directed toward reducing the length and periodicity of transmissions to an absolute minimum.

It is understood that the Commission is not presently licensing any industrial frequencies other than microwave for continuous carrier operation.

Although the rules state that applications for developmental frequencies need not be accompanied by evidence of frequency coordination, it is felt that in this case the importance of these frequencies warrants coordination, even if only on a voluntary basis. It is unfortunate that all of the industrial Services do not have frequency coordinating bodies as effective as the NPRFCA, but since they don't, services that must share frequencies may then be deprived of maximum efficient utilization of the already small fraction of the radio spectrum to which they have access. It is hoped that lack of coordination will not negate much of the usefulness of these frequencies and that potential benefits from the many applications for a remote control medium, such as this, will be realized. —**The End**

About the Authors

Van Burkleo

Barnette

Glenn G. Van Burkleo is a senior engineer with Humble Oil & Refining Company. He joined Humble eight years ago after graduating from Oklahoma State University with a B.S. degree in electrical engineering. A registered professional engineer in Texas and Oklahoma, Van Burkleo has served on the NPRFCA advisory committee and is presently on its Region IV Engineering Committee. He served in the Army Signal Corps during World War II and as a radio operator in the Merchant Marine.

L. A. M. Barnette, a supervisor engineer joined Humble Oil & Refining Company following graduation from Rice Institute with an engineering degree in 1932 and a professional degree in 1933. He has been active in many industry communications groups and committees for a number of years and has presented several papers before these groups. Barnette is a senior member of the IRE and was Houston area organizer for its professional group on vehicular communications; he has served on several committees of the PIEA and is a member of the NPRFCA, now serving as chairman of Region IV. He has served on the API Central Committee on Communications Facilities, including chairmanship posts since 1948. He is a registered professional engineer in Texas.

HOW TO REMEMBER PART 2

The Two Processes of 'Memory'

Recall and recognition are the two ways for remembering previously learned material. You'll learn all about these two plus some valuable information about why you sometimes forget

By John D. Quinton, Training Dept. Tennessee Gas Transmission Company, Houston

IN THE FIRST PART of this article (Page 51, April PIPE LINE INDUSTRY) we discussed the learning process which emphasized "acquiring" knowledge. We considered such items as the intent to learn, paying attention, learning names and faces, looking for meaning, proper mental set, and many others.

Now, in turning to remembering and forgetting, we will give special attention to the processes of retaining what we have learned and the why's and wherefore's of forgetting.

REMEMBERING

Memory or remembering is the retaining of all or part of what we have acquired. Once again it should be emphasized that efficient learning will bring about good retention; i.e., memory.

There are two processes of remembering. Let's consider each separately and see the likenesses and differences of each.

1. Recall. This term is generally used when you are trying to remember some specific thing that you have learned. One of the main causes for failure to recall is the interference of other recalled material. For example you are asked, "Do you recall the name of the fellow that fixed the car?" The many names that flood your mind are cases of recall, too. This interference can cause the name you are seeking to escape you. To remedy this, do not try to recall the name for a time and give your mind a "rest." As the other names gradually drop out by your rejecting them, the correct one will appear.

You will notice that in recall, you use no visual cues or multiple choice answers. If such aids are used, then the remembering process is not recall but recognition.

To test your own or another's immediate recall, or memory span, try the following test. Here are a series of digits ranging from 4 to 12. Read each series of digits to a friend and let him repeat them. Continue giving him an additional digit each time until you have reached his limit. This is all he can recall and is known as his memory span.

2571
36497
584135
3969152
50719647
369260851
3041698934
74650143962
797239517152

2. Recognition. Recognizing material from our past experiences is much easier than recalling. That is one reason students prefer multiple-choice and matching questions rather than completion and essay. The answer is before them and they don't have to recall it.

To test yourself on your recognition ability, examine the following symbols for one minute. Then look on the next page and check the ones that you saw in the group below.

You will note that you had some

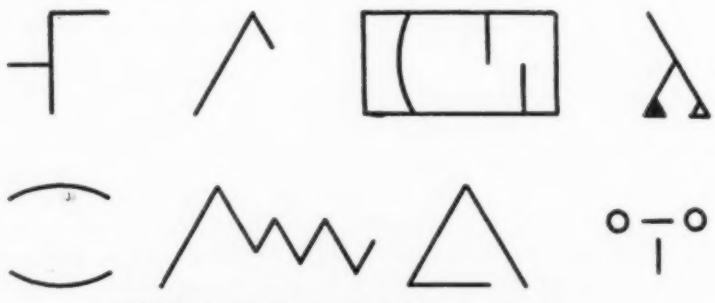


FIGURE 3—Test your ability to recognize.

false-recognition. Some of this is due to figure similarity but much of it is due to your own wishes, desires, goals, etc. In short, our personalities determine, to a degree, how good our memory is.

FORGETTING

It is hardly necessary to demonstrate the process of forgetting for, unfortunately, it is no stranger to any of us. But it might help us to remember better if we know the how and why of forgetting.

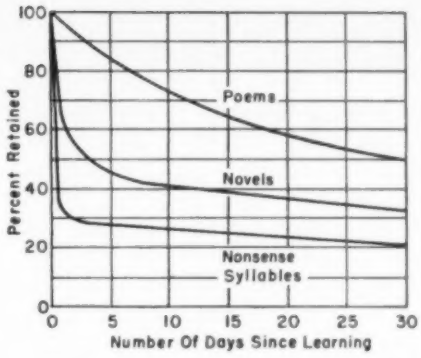


FIGURE 4—Forgetting follows a definite pattern.

1. Rate of Forgetting. Regardless of the causes for forgetting, it tends to follow a definite course. Look at Figure 4 which shows some typical forgetting curves.

You will note immediately the rapidity with which we forget. This rapid deterioration is true for all of us. In fact, many people are rather startled when they realize that within one or two days over 50 percent of what they learned is gone.

This suggests very strongly that we should repeat our practice and drill (overlearning) immediately after the original learning. (Overlearning was discussed in detail in Part 1. This means at least by the next day if we wish to retain the material permanently.

It is also quite apparent from this graph that forgetting occurs at different rates due to the type of material learned. The more meaning the material has, the less the rate of forgetting. This substantiates the "look for meaning" rule of learning (also discussed in Part 1).

2. Why Do We Forget? Taking a cue from the forgetting curve, the first answer would seem to be that we forget because the neural traces grow dimmer with the passing of time. Studies show, however, that there is more to forgetting than just the lapse of time. More important, it seems, is what takes place during the time between learning and remembering. Many experiments have shown that if there is no mental activity between the learning and the reproducing of the material, forgetting will be less than if there is some form of mental activity.

For example, if a group of children studied a poem for 30 minutes, then one half rested their heads on their desks and the other half studied arithmetic for 30 minutes, the inactive group would remember more of the poem. This is known as "retroactive inhibition."

This suggests that we should keep relatively inactive between the time we learn a speech, formula, facts for a conference, etc., and the time we want to remember the learned material.

This inactivity will pay even more dividends if it is spent in sleep. For studies show that you will remember more of what you have learned if you go to sleep immediately after the learning period. This suggests that if you are preparing for an important project on the morrow that, instead of learning your material early in the evening and then have some social activity, it would be better to learn the material after the activity and go straight to bed.

We can say, then, that the interference of new material is as significant if not more significant than the mere lapse of time in causing rapid forgetting.

3. Emotion and Forgetting. If a person has never experienced the feeling of frustration and embarrassment because he couldn't recall a name which he "knows as well as my own," then he is fortunate indeed. This seems to be a malady that befalls nearly all of us. The well rehearsed speech is suddenly forgotten when the toastmaster says, "And here is our speaker for the evening, Mr. Brown." And the embarrassment when we start to introduce our best friend to an important person and we can't remember the friend's name.

What causes this sudden forgetting? The emotions are causing a great deal of the difficulty. As some wag has said, "When the emotions come in the door our memories and intelligence go out the window."

Fear, anxiety, excitement, love, hate, all interfere with our memories. This is illustrated by the incident where the groom forgot the bride's name after the wedding ceremony.

To counteract this common pitfall, you should try to keep a "cool" head. Slow down, take a deep breath, and take the pause that refreshes the memory.

In closing, it might be wise to reemphasize the fact that the use of any memory "system" to help facilitate remembering does not develop an entity called "memory." If the system does help the person to remember, then it is teaching him better and more efficient learning techniques. In addition, if the person does not continue to use the principles and methods of efficient learning his "memory" will return to its former state of inefficiency.

—The End

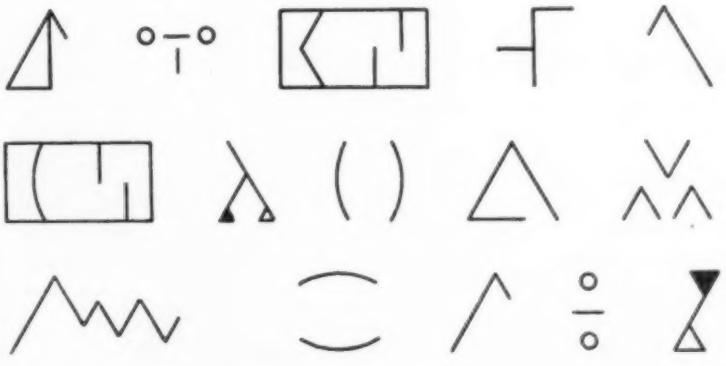


FIGURE 5—Check the same symbols which appeared in Figure 3.

Pipe Line Pete's

IDEAS FOR THE FUTURE!

. . . in pipe line engineering, construction and operations

By Donald M. Taylor, Engineering Editor

Micromachining—100 Million Components Per Square Inch!

Stanford Research Institute is well along the road toward developing techniques for using electron beams as tools for micromachining. Such techniques will permit fabrication of 100 million components and interconnections in an area of one square inch.

What is the purpose of this technique? To develop a computer which will rival a human brain in thinking ability—yet have a speed 10 million times greater. The switching time of the components of such a computer will approximate one-tenth of a billionth of a second.

The technique that makes the machining of such components—100 billion to the cubic inch—possible is called "electron beam activated micromachining!" It shapes metal and insulator films of submicroscopic dimensions by effecting chemical and physical reactions with low-energy electron beams.

What's Going on in Research

Research work has reached fantastic proportions in the U.S. For example, one university—New York University —now has more than 150 research projects supported by government, industry and research foundations! Here are some of these projects:

1) Mechanisms of combustion and ignition in organometallic compounds; 2) Development of high energy solid propellants; 3) Preparing acetylenic compounds for ram and turbo-rocket fuels; 4) Evaluation of aluminum and concrete bridges; 5) Synthesis of hyper-pure metals; 6) Geodetic surveying from satellites; 7) Ocean-atmosphere interaction problems; 8) Raindrop coalescence; 9) Miniaturization of electronic components; 10) Air and water pollution.

Multiply this by hundreds of other research laboratories and institutes and you can visualize the vast effort which is forging our way into a highly technological future.

Electronic Unit to Analyze Dreams

When you dream your lips move imperceptibly and your vocal cords give off subvocal sounds. Why not, reasoned a group of University of Chicago doctors, record these movements which cannot be seen and sounds which cannot be heard and translate them in terms of symbols for interpretation? An Illinois Bell Telephone staff engineer has devised such an instrument according to Armour Research Foundation "news letter" and it is now under test.

Got Any Ideas? Tell 'em to the Armed Forces

If you are a would-be inventor, this may be your big chance. Our armed forces have requested that civilian inventors supply some 300 new ideas ranging from fuels for space vehicles to instant sauces, dressings and condiments to make serviceman's dehydrated foods more palatable.

The National Inventors Council, U.S. Department of Commerce, Washington 25, D. C., will supply a list of the 300 problems which present challenges in almost every field of science. What's more, the council promises to review every single idea sent to them. The best ones will be passed on for further processing.

Here are some of the 300 ideas needed: Lightweight laundry equipment which uses little or no water; a device to boil a bucketful of water in five minutes; seals to prevent gas leakage at exceedingly high pressure and heat, and a machine which will make round threaded metal parts out of square, round or irregular pieces automatically in about 15 minutes.

20,000 HP Gas Turbine Will Power Hydrofoil Boat

A large hydrofoil boat powered by a 20,000 hp gas-fired turbine developed by General Electric Co. is being built for the U. S. Maritime Administration. The engine is patterned after powerful, jet aircraft engines. A 24-foot experimental boat powered by a 900 hp turbine has reached speeds of nearly 70 miles per hour.

Rules of Thumb

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Engineering Design

—77—How to Estimate the Discharge of a Centrifugal Pump at Various Speeds

Within the design limits of a pump, the discharge will be approximately proportionate to the speed.

$$Q_2 = Q_1 \frac{N_2}{N_1}$$

where Q_1 is the gallons per minute at a particular speed N_1, and Q_2 is the gallons per minute at N_2.

Example: **If a pump delivers 350 gpm at 1,200 rpm** what will it deliver at 1,800 rpm?

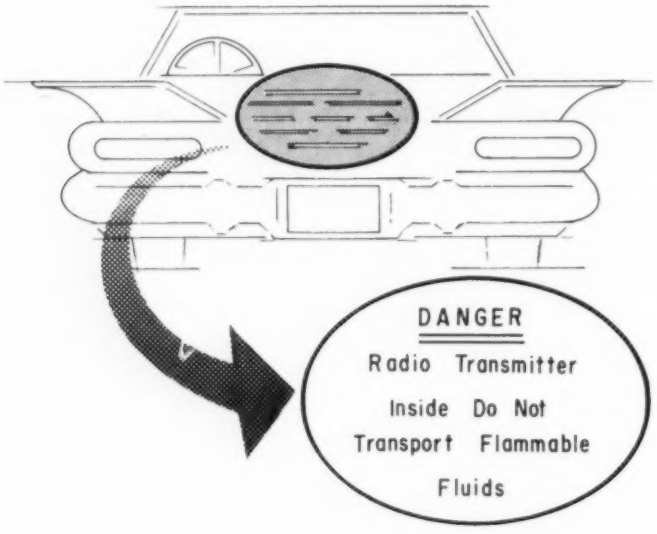
$$Q_2 = 350 \times \frac{1800}{1200} = 525 \text{ gpm.}$$

Similarly, for a given pump design head varies as the square of the impeller speed and power as the cube of the speed.

How to do it

PIPE LINE HINTS

$10 is paid for each illustrated acceptable contribution. Mail to The Editor, PIPE LINE INDUSTRY, P. O. Box 2608, Houston 1, Texas

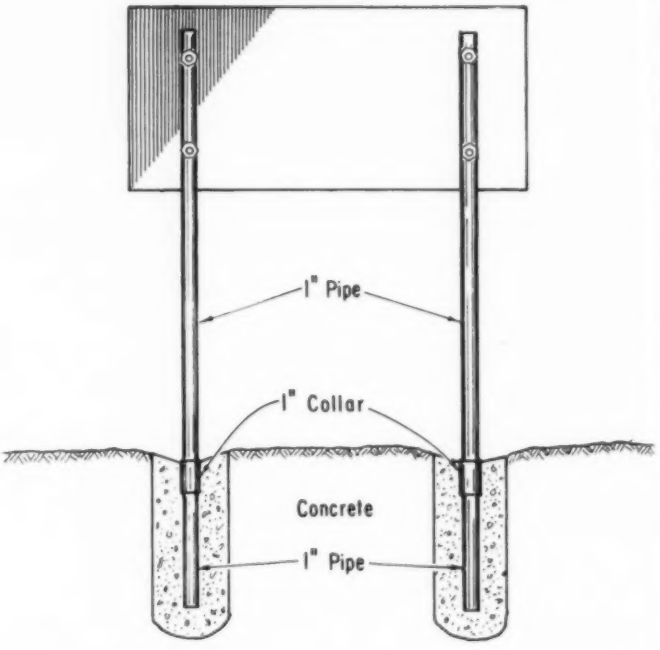


Decals on Car Trunks Can Prevent Dangerous Explosions

"Danger! Radio Transmitter inside. Do not transport flammable fluids!"

A decal warning such as this spotted on the outside—or even the inside of the trunk of company automobiles may prevent a dangerous explosion. Automobile radio transmitters are not explosion proof, and there is every liklihood that a proper concentration of gasoline and air in the trunk of a car will be ignited the instant the transmitter starts up.

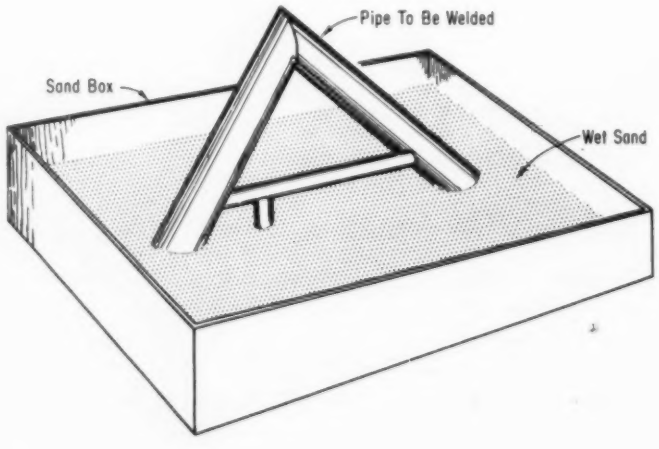
Most gasoline cans breathe in and out, and the average "safety" can with its spring-loaded cap is the worst of all. This means that a can of gasoline should *never* be transported in the same trunk with a transmitter. This warning may help prevent an explosion.



Removable Signs Make It Easier to Mow Station Yard

The various signs in a station yard—identifying the station, the valves, the emergency shut-offs, etc.—can be installed for easy removal at no added cost and at the same time make it easier to maintain the station yard.

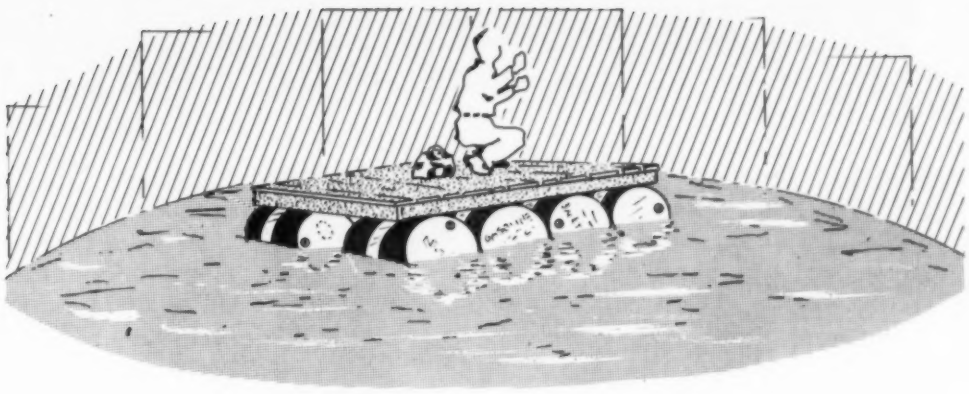
Shown in the accompanying drawing is a sign foundation which can be poured "neat" (meaning it can be formed by the earth itself). The sign can be readily disassembled when it is time to mow the lawn, leaving no obstruction.



Sand Box Helps Simplify Welding Complex Piping

Take a tip from Junior's sand box the next time you have to weld or braze complex parts or structural shapes. Simply inbed them in the sand—carefully adjusting them to proper position. Then tack the pieces together and begin welding.

If you are trying for precision in positioning the pieces, simply moisten the sand before using it.



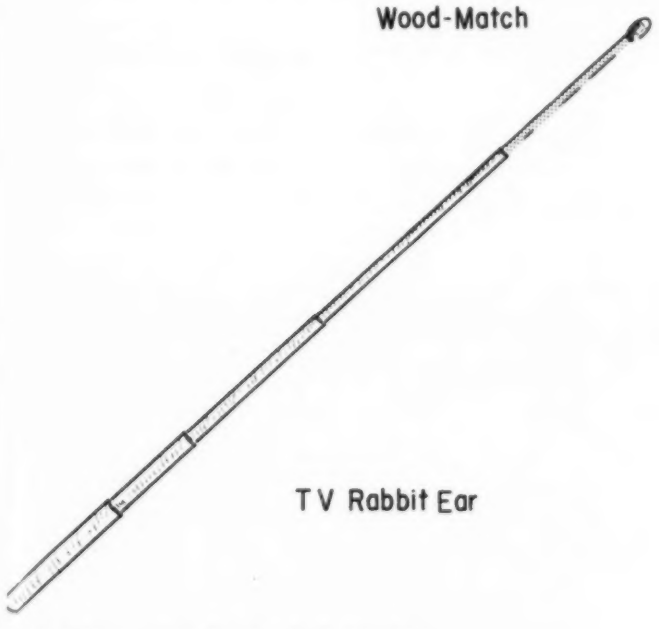
Fill Tank with Water and Use Raft to Make Internal Repairs

When roofs on large diameter storage tanks must be replaced, here's a simple, economical and time-saving method devised by a major pipe line company overseas.

To eliminate the need for conventional scaffolding which takes money and time, several small rafts were fabricated using surplus logs tied onto eight empty oil drums. First the tank was drained of oil; rafts were then constructed inside the empty tank. Tank then was refilled with *water* to lift rafts to desired distance from the tank roof.

Repairmen working from the rafts were able to do the job with greater ease and safety. One reminder—this overseas company used life jackets on workmen—and they should be qualified swimmers.

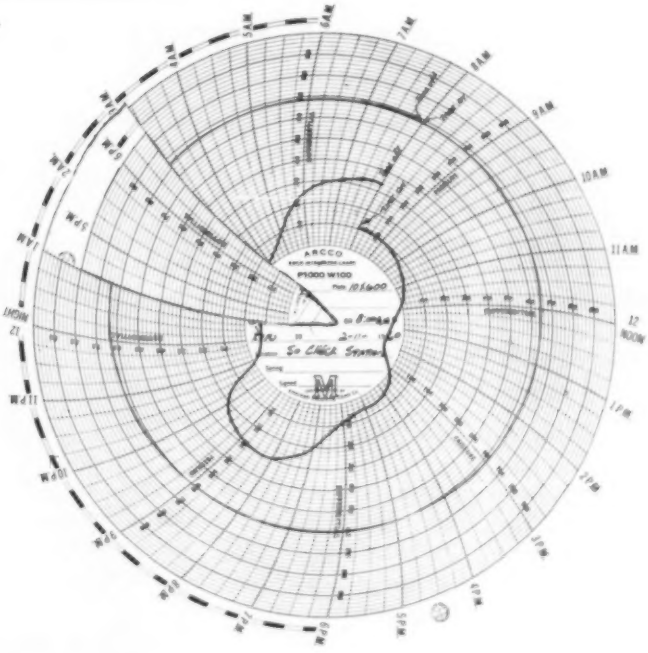
To reclaim the rafts, tank was drained again, rafts disassembled and logs and drums removed from tank.



Utilize TV Rabbit Ears As Light-Off Extensions

What do you do with old TV rabbit ears? One use is to make light-off extensions to eliminate the hazard of lighting field furnaces, heaters, etc.

Simply insert a wooden match in the end of the tubing, strike it and poke it right inside the heater fire box. This eliminates the danger of singeing your hand and arm, at the same time it could possibly prevent severe burns if the heater flashes. After use, the rabbit ear telescopes to tool box size.



You Can Get a Chart Reading Below Zero

How do you read the differential when it goes below the zero point—possibly when flow reverses? One way is to cut a strip from the meter chart, lay it on the chart and get a close estimate of the values below zero as shown. This was the solution devised by field men who had to read a check station meter every hour. Of course, actual quantities will be determined by planimeter.

WHAT'S HAPPENING IN PIPE LINE CONSTRUCTION

By Donald G. DePugh, Construction Editor

Shell Pipe Line Plans New Buildings

Shell Pipe Line Corporation will construct a new technical development laboratory building and office for the Texas-Gulf Division in Houston. The laboratory will include four general laboratories, a heavy equipment laboratory, 12 offices, conference room, shop, library, lunchroom and darkroom. Buildings are scheduled for completion in 1961.

Texas Eastern Announces New Expansion; Lets Contracts on 200 Miles of Gas Lines

Texas Eastern Transmission Corporation announced plans for a $17.5 million expansion program which it hopes to construct this year. Texas Eastern has filed with the Federal Power Commission seeking permission for 66 miles of 30-inch loops and the addition of 33,710 horsepower in four existing gas compressor stations plus metering and regulating facilities.

The loops will be added along the Texas Eastern main line between Vidor, Texas, and Lambertville, N. J. The expansion will provide an additional 50 MMcf of gas per day delivery to 15 present customers.

Texas Eastern also has let contracts on another major construction project pending FPC approval. H. C. Price Co., Western Pipe Line, Inc., and Sharman, Allen, Gay & Taylor Inc., have been awarded contracts on 200 miles of 20-36-inch in Pennsylvania and New Jersey.

Ajax Alberta Plans 28-Mile Gas Extension

Ajax Alberta Pipeline Ltd., plans to lay a 28-mile, 10-inch main line extension from Morinville to Westlock near Edmonton.

Arabian American Oil Co. Laying 73 Miles, 30-Inch

Arabian American Oil Company has started construction on 73 miles of 30-inch loop line along its Safaniya-Ras Tanura crude line. The $11 million project will increase delivery to 215,000 barrels per day from Safaniya field and 75,000 barrels daily from Khursaniyah field.

The first section of the loop consists of 22 miles starting seven miles north of Khursaniyah station and extending 15 miles south of the station. The remainder of the looping project will extend to Ras Tanura and will be completed by October.

Contracts Awarded For Alaska Gas Pipe Line

Anchorage Gas Corporation has let contracts on construction of its Alaska pipe line from Kenai gas field to Anchorage. Williams Brothers Company will lay the 74 miles of 12-inch main line and Sharman, Allen, Gay & Taylor, Inc., will construct twin 12-inch underwater crossings in the $12 million project. The line will be built and operated by Alaska Pipe Line Co.

Anchorage hopes to have line completed by October in time for the next winter season.

Interstate Oil Pipe Line Lets Contract on 20 Miles

Sharman, Allen, Gay & Taylor, Inc., has been awarded a contract to lay 20 miles of 8-inch crude line for Interstate Oil Pipe Line Company in Jones County, Mississippi.

Panhandle Eastern Plans 200-Mile Gas Lateral Line

Panhandle Eastern has filed an application with the Federal Power Commission seeking approval for a 200-mile 22-24-inch gas lateral line from Elk City, Okla., to the Haven, Kan., compressor station.

The line would provide an additional 150 MMcf of gas daily to come from Shell Oil Company.

Latex to Lay 35 Miles For South Carolina Gas Co.

Latex Construction Company will construct 35 miles of 4, 6 and 8-inch gas lines for South Carolina Gas Company. The line extends from a point 11 miles south of Batesburg, S. C., to a point near Edgefield, S. C.

Transco Lets Contract On 23-Mile Offshore Line

Transcontinental Gas Pipe Line Corporation has awarded a contract to Brown & Root, Inc., for construction of 23 miles of 20-inch gas lines. The lines will be installed in offshore Louisiana area.

Augusta Merges With Kaneb Pipe Line Company

Augusta Pipe Line Company has been merged with Kaneb Pipe Line Company. Kaneb operates a 570-mile products line in Kansas and South Dakota, and Augusta's system consisted of a 50-mile line between Eldorado and Arkansas City, Kan. The systems are connected.

Texas Gas Transmission Lets Contract to Western Pipe Line

Texas Gas Transmission Corporation has awarded contract to Western Pipe Line, Inc., to build 17 miles of 10-inch pipe line in Lafourche Parish, La.

Buckeye Pipe Line Company Lets Contracts on 41 Miles

Buckeye Pipe Line Company has awarded contracts on 41 miles of 16 and 22-inch crude lines in Michigan and Ohio. Somerville Construction Company will lay 27 miles of 16-inch between Samaria and Trenton, Mich., and Panama-Williams Corporation will construct 14 miles of 22-inch between Samaria and Toledo, Ohio.

This is part of a 54-mile main line from Toledo, Ohio, to Samaria and Detroit.

Columbia Gulf Awards River Crossing Contract

J. Ray McDermott & Co. was awarded a contract for construction of two 24-inch lines under the Mississippi River for Columbia Gulf Transmission Co. Construction of the new line was made necessary by caving action of the river on the banks. The line is scheduled for completion by December 1.

Humble Lets Contract On 63-Mile Crude Line

H. S. Shanks & Sons is constructing a 63-mile crude line for Humble Pipe Line Company. The line extends from Maverick to Pearsall, Texas.

Construction Moves Ahead on Crude, Gas Lines in Algeria and Tunisia

Construction is progressing on the Edjeleh-Tunisia crude line and Sahara gas line from Hassi R' Mel to the Mediterranean coast.

GREP, a joint venture between Societies Entrepose and Parisienne Pour L'Industrie Electrique, has completed the 310-mile Tunisian part of the 24-inch crude line extending from Edjeleh field, Algeria, to Mediterranean coast of Tunisia. GREP also is building the gathering systems in Edjeleh and Zarzaitine fields.

On the 24-inch gas line, GREP is laying the 210-mile section through the Sahara.

Societe des Grands Travaux de Marseille is constructing the 110-mile, 16-inch section of the gas line between Relizzane and Affreville, in northern Algeria, for the Electricite et Gaz d'Algerie (Natural gas of Hassi R'Mel). This work is being carried out as a joint venture with the Entreprise Moderne de Canalisations.

The French contracting company also is working on a 22-inch submarine line at Pointe Indienne, near Pointe Noire, Congo, for the Societe des Petroles D'Afrique Equatoriale Francaise.

Their portion on the 24-inch crude line from Zarzaitine to the Mediterranean has been completed.

Tunisia-to-Sicily Crossing Of Mediterranean Considered

Plans are being considered for a gas pipe line submarine crossing of the Mediterranean from Tunisia to Sicily. The line would originate at Hassi R'Mel gas field in central Algeria and extend to Cape Bon in Tunisia. From there it would go under the Mediterranean to Marsala, Sicily and would be extended into northern Italy.

The distance is 560 miles from Hassi R'Mel to Cape Bon and the underwater crossing would be 77 miles. Soc. Siciliana Metanadotti would build a 1,000-mile system through Italy and possibly extend it into West Germany.

A survey and further studies of the Mediterranean bottom between Tunisia and Sicily are under way presently.

Gas Trunk Line Plans 250-Mile Gas System

Gas Trunk Line of British Columbia Ltd., plans to construct a 250-mile, 30-inch gas pipe line system from Fort Nelson to Taylor, B. C.

Cost of the first step of the new project, which includes drilling of wells in already-discovered fields, will exceed $100 million. The pipe line system will include gathering lines and plant facilities. Capacity of the line will be about 650 MMcf daily.

El Paso Gas Supply Co. Plans 228-Mile Gas Line

El Paso Gas Supply Company plans to lay a 228-mile, 30-inch gas line from Live Oak to Sutton County, Texas. El Paso Gas Supply's parent company, El Paso Natural Gas Company, will take the gas at its Sonora plant in Sutton County. Gas would be supplied by Houston Pipe Line Company and Coastal States Gas Producing Company. Cost of the project will be about $30 million.

International Controls Hosts International Students

Inspecting remote control equipment, foreign students from six countries gather around International Control Corp.'s control equipment at its plant in Houston. The visitors were at Lee College, Baytown, Texas, attending the semi-annual pipe line technology school sponsored by the University of Texas Petroleum Extension Service and API Division of Transportation. From left to right, Ralph Watkins, International Controls; J. A. Van de Veer, Shell de Venezuela; Eric Friessner, Andian National Corp., Columbia, S.A.; Edward Browne, Burmah Oil Co., London; Ettemad Mahood, NIOC, Teheran, Iran; Yehoshua Goldstein, Consolidated Refineries, Israel; Terry W. Russell, Jr., International Controls; Javad Sharifi, NIOC, Teheran, Iran; and Christopher J. Tucker, Shell de Venezuela. Not shown is Bernard Raffaelli, Eau and Assainissement, Paris. The school was conducted by J. E. Conway, The University of Texas.

PROPOSED PIPE LINE CONSTRUCTION

Here in convenient summary form is Pipe Line Industry's listing of company, line size, length, service, location and project status.

U. S.

Algonquin Gas Transmission Co., Boston, 25 miles, 20-inch; 8 miles, 8-inch, gas, and 12,000 hp addition in Massachusetts, $6 million, before FPC.

Anchorage Gas Corp., Houston, 165 miles, 12-inch, gas, Kenai to Anchorage, Alaska, $15 million, planned.

Arkansas Industrial Pipeline Corp., Shreveport, 130 miles, 18-inch, gas, Perla-to-Helena, Ark., $9 million, under way, company crews.

Arkansas Louisiana Gas Company, Shreveport, La., 58 miles, 2-6-inch, gas, planned.

Belle Fourche Pipeline Co., Casper, Wyo., 103 miles, 8-inch, crude, Fiddler Creek field to Lance Creek, Wyo., and branch lines from North Donkey Creek field to Rozet and Miller Creek fields, $2¾ million, before Wyoming Public Service Commission.

Buckeye Pipe Line Co., New York, 54 miles, 16-22-inch, crude, main lines from Toledo to Samaria, and Detroit, Mich., $4 million, contract let on 41 miles of 16- and 22-inch to **Panama Williams Corp.** and **Somerville Construction Co.**

Carolina Pipeline Company, Columbia, S. C., 85 miles, 8-inch, gas, in South Carolina, $5 million, before FPC.

Cenex Pipeline Company (subsidiary Farmers Union Central Exchange, Inc.), St. Paul, 200 miles, 8-inch, products, Glendive, Mont., to Minot, N. D., contracts let to D. **Michael Curran & Co.,** and **C. E. Wilson Construction Co.**

Coastal States Gas Producing Co., Corpus Christi, Texas, 60 miles, 10-inch, gas, gathering, La Salle and Frio counties, Texas, before FPC.

60 miles, small diameter, gas gathering line, to tie in with system under construction and extend to Pearsall County, Texas, planned.

25 miles, gas, Associated Gas & Oil Co. field to South-Tex Corp., processing plant west of Corpus Christi, Texas, planned.

37 miles, gas gathering in Brown, Eastland, Comanche and Erath counties, Texas, planned.

Coastal Transmission Corp., Houston, 81 miles, 3 to 10-inch, gas, laterals; 5,500 hp in stations at Port Lavaca, Texas, and Eunice, La., and additional 1,500 hp at Robstown, Texas, $6.2 million, before FPC.

Colorado Interstate Gas Co., Colorado Springs, 140 miles, 34-inch, gas, Green River, Wyo.,-to-Provo, Utah; 109 miles, 26-inch, Texas Panhandle to southeastern Colo., 136 miles, 34-inch, southeastern Colorado-to-Pueblo, Colo.; 107 miles, 30-inch, Pueblo-to-Denver, $91 million, before FPC.

Colorado Oil & Gas Corp., Denver, 400-miles, gas, from Gubik field to Fairbanks, Alaska, planned.

Columbia Gulf Transmission Co., Houston, 12.8 miles, 6 and 20-inch, gas, loop line in Louisiana, $730,000, authorized.

Continental Pipe Line Co. (joint venture with Husky Oil Co.), Ponca City, Okla., 85 miles, 6-inch, products, Helena to Great Falls, Mont., planned.

East Coast Pipeline Co., 90 miles, 12- to 24-inch, products, Linden, N. J. to Suffolk County, N. Y., $25 million, planned.

El Paso Gas Supply Company, El Paso, Texas, 228 miles, 30-inch, gas, main, Live Oak to Sutton County, Texas, $30 million, planned.

El Paso Natural Gas Company, El Paso, 199 miles, 30-inch, Permian-San Juan crossover loop, before FPC.

17 miles, from Pacific Gas Transmission Co. facilities to near Spokane, Wash., before FPC.

34 miles, 20-inch, Puckett to Goldsmith, before FPC.

23 miles, 20-inch, Goldsmith to Eunice-Plains line, before FPC.

9 miles, 20-inch, Goldsmith-Plains loop, before FPC.

43,600 hp in new and existing stations in Texas, Oklahoma, New Mexico and Utah, before FPC.

400 miles, 34-inch, Salt Lake City, Utah, to California border, before FPC.

Equitable Gas Company, Pittsburgh, Penn., 31 miles, 16-inch, and 26 miles, 20-inch, in West Virginia and Pennsylvania, $5 million, before FPC.

12½-miles, 16-inch, paralleling existing system in Harrison and Marion counties, W. Va., authorized.

Goliad Corp., Houston (Joint venture with **Union Oil Co. of Calif.**), 85 miles, LPG, Kaplan, La. to Baton Rouge, extraction plant at Kaplan and fractionation plant at Baton Rouge, $12 million, planned.

Great Northern Railway, St. Paul., 110 miles, crude, fields in Burke and Bottineau counties to Minot, N. D., $3½ million, Public Service Commission authorization.

Hope Natural Gas Co., Clarksburg, W. Va., 45 miles, gas, from West Virginia to Pittsburgh area, planned, 20 miles, 24-inch, gas, in Wertzel and Monongalia counties, W. Va., authorized.

Houston Texas Gas & Oil Corp., St. Petersburg, Fla., 199 miles, 2 to 6-inch, gas, laterals; 20,000 hp in five new stations; $12 million, before FPC.

Humble Pipe Line Company, Houston, 63 miles, 8-inch, crude, and gathering system Sacatosa field, Maverick County to Pearsall, Texas, planned.

Iron Ranges Natural Gas Co., 115 miles, gas, from Itasca and St. Louis counties along route of Mesabi range from Grand Rapids to Aurora, Minn., $5 million, FPC authorization.

60 miles from Duluth to Silver Bay, Minn., FPC authorization.

Kansas-Nebraska Natural Gas Co., 15 miles, 12-inch, gas, loops and 4,800 additional hp at new and existing stations, $1.5 million, FPC authorization.

Laclede Gas Co., St. Louis, 107 miles, 24-inch, gas, Hallsville to St. Louis, Mo., planned.

Manufacturers Light and Heat Company, Pittsburgh, 103 miles, 20-inch, gas, in Franklin, Adams, Fayette, Green, Fulton and Somerset counties, Pa., $7 million, contract let on 70 miles to Williams Bros. Co.

Matador Pipe Line Corp., Denver, 175 miles, crude, from Bottineau, Burke and Renville counties, N. D., to Cromer, Man., Canada, $4 million, proposed.

Michigan Wisconsin Pipe Line Co., Detroit.

66 miles, 24-inch, loops, Indiana, Illinois, and Michigan, authorized.

342 miles, 24-inch, gas, loops, Kansas, Missouri, Illinois, and Iowa, before FPC.

123 miles, 30-inch, loops, between Sandwich, Ill and Big Rapids, Mich., before FPC., contracts let on 530 miles to R. H. Fulton, Bechtel Corp., Somerville Construction Co., and Majestic Contractors.

37 miles, 6 and 12-inch lateral loops in Wisconsin, before FPC.

29 miles, 30-inch, loops, Illinois, Indiana, and Michigan, 3,000 hp. station, Janesville, Wis., before FPC.

Two 2,000 hp units at Meade, Kansas; one 2,000 hp unit at Havensville, Kansas, before FPC.

Midwestern Gas Transmission Co., Houston.

504 miles, 24-inch, gas, from Minnesota-Canada border near Winnipeg to Marshfield, Wis., $52 million, FPC authorization.

Mississippi River Fuel Corp., St. Louis, 20 miles, 12-inch, 3 miles, 4-inch, gas, 2,500 hp station, to develop underground storage reservoir at St. Jacobs field in Madison and St. Clair counties, Ill., $3 million.

Mississippi River Transmission Corp., (subsidiary Mississippi River Fuel), 115 miles, 24-inch, gas, southeast Missouri to St. Louis County, planned.

Mustang Fuel Corporation, Oklahoma City, 8 and 12-inch gas system, central Oklahoma to Oklahoma City, Sulphur and Muskogee, Okla., contracts let to **Sadler Bros. Pipeline Construction Co.,** and **Montin-Harbert Pipe Line Construction Co., Inc.**

Continued on Page 60

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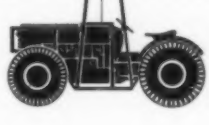

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PROPOSED CONSTRUCTION

continued

Natural Gas Gathering Co., Inc., (joint venture with Gulf Resources, Inc.) gas gathering facilities in Zapata and Starr counties Texas, before FPC.

Natural Gas Pipeline Company, Chicago. 151 miles, 36-inch, gas, loops, between Ford County, Kansas and Joliet, Ill. and 180 miles, 24-inch, main, from Minneola, Kan. to Kiowa County, Okla., $31 million, before FPC.

New Haven Pipeline, Inc., products line, New Haven, Conn. to Springfield, Mass., $2.5 million, planned.

Niagara Mohawk Power Corp., 122 miles, 12-inch, Watertown and Massena, N. Y., contract let to Fulghum Contracting Corporation pending FPC approval.

Northern Natural Gas Company, Omaha.

46 miles, main line extensions, 191 miles, loops, 1,767 miles, branch lines, and 45,400 additional hp, in Iowa, Minnesota, South Dakota, Nebraska, Wisconsin and Illinois, $76.7 million, FPC authorization.

37 miles, 30-inch, Bushton compressor station to Otis field, Kansas, 7,000 additional hp at Bushton, and development of underground storage facilities at Otis field, $20 million, before FPC.

Ohio Fuel Gas Co., 59 miles, gas, 4-24-inch main lines, in Belmont, Carroll, Cuyahoga, Fairfield, Logan, Lorain, Marion, Muskingum, Stark and Wayne counties, Ohio, $5.1 million, planned.

Pacific Gas & Electric Co., San Francisco. 296 miles, 36-inch, gas, from Malin, Ore., to Antioch, Calif., southern section of line from Canada to California, $82 million before California Public Utilities Commission.

10 miles, 20-inch, Pittsburg to Walnut Creek, Calif. planned.

2.7 miles, 16-inch, Marin County, Calif., planned.

4.4 miles, 16-inch, Sonoma County, Calif. planned.

7.5 miles, 16-inch, south of Fresno, Calif. planned.

Pacific Gas Transmission Co., San Francisco, 614 miles, 36-inch, Kingsgate B.C. to Malin, Ore., northern section of Canada to California line, $133 million FPC Examiner Approval.

Panhandle Eastern Pipe Line Co., Kansas City, 305 miles, 30-inch, 40 miles, 26-inch, gas, loops, and 43,000 hp, and gathering facilities, $60 million, before FCP.

200 miles, 22-24-inch, gas, lateral from Elk City, Okla., to Haven, Kan., before FPC.

Peoples Gas Light & Coke, Chicago, 29 miles, 36-inch, gas between North Shore and Calumet stations, planned.

Peoples Gulf Coast Natural Gas Pipeline Co., Chicago. 371 miles, 30-inch, loops, and 45 miles, gas laterals, 6,700 hp in Victoria County, Texas, $43.5 million, before FPC.

Rio Gas Gathering Co., San Antonio, 97 miles, 3 to 8-inch, gas gathering, South Texas, to supply gas to El Paso Natural Gas Company, planned.

Rocky Mountain Natural Gas Company, 65 miles, gas, southwestern Colorado to serve Delta, Orchard City and Montrose, Colo., planned.

Southern California and Southern Counties Gas Cos., Los Angeles, 93 miles, 34-inch, California-Nevada border to Newberry, Calif., approved.

Standard Oil Company of California, 22 miles, 8-inch, crude, Kenai Peninsula to Nikiski, Alaska, $4 million, considered.

St. Lawrence Gas Company, Inc., Ogdensburg, N. Y., 75 miles, gas, main, United States-Canadian border to Ogdensburg, N. Y., $3.4 million, FPC examiner approval.

Tennessee Gas Pipeline Co., Houston 191 miles, 30 and 36-inch loops, in Ohio, Pennsylvania and New York, 72 miles of gathering lines and 43,600 hp in five stations, $46 million before FPC.

158 miles, 36-inch, gas, loops in Mississippi and Louisiana, FPC authorization.

21 miles, 16-inch, 2 miles, 12-inch, gas, Louisiana coast, Vermilion blocks 46 and 64, $3 million, before FPC.

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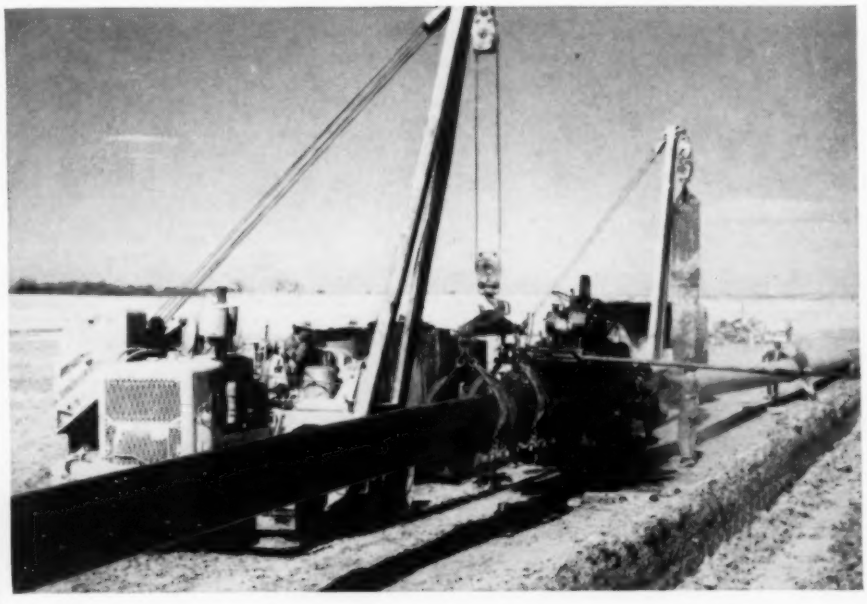

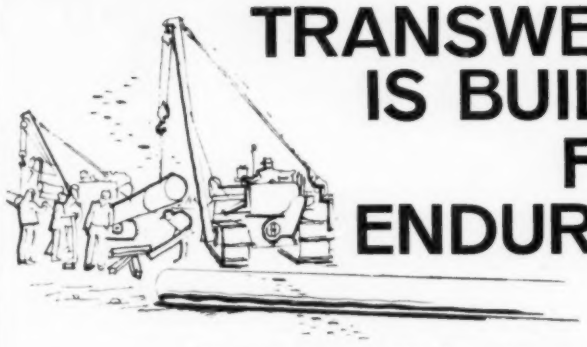

TRANSWESTERN IS BUILDING FOR ENDURANCE!

The Transwestern Pipeline Company line, with 1600 miles under construction from Fort Stockton, Texas and the Texas Panhandle to near Needles, California, will serve West Coast consumers with natural gas for many, many years to come. Its underground lines and structures are being installed with coal-tar enamel coating for high integrity electrical insulation and life-long corrosion protection. Reilly Hot Service Enamel with HS X-10 Primer and Reilly Intermediate Enamel with Q.D. Primer have been specified along with Coal Tar Enamels of other manufacturers and will serve as the engineering material of choice for corrosion mitigation.

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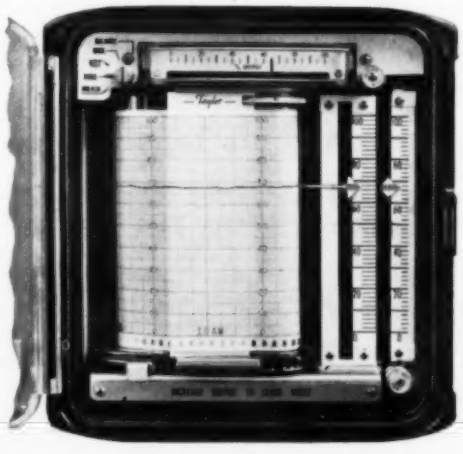
- Provides smoother transfer of suction discharge pressure and/or flow override control because there is no "reset wind-up".
- Much faster than any other electronic controller—flat out to 120,000 cpm.
- Rate action available down to 0.0016 mins.
- Gives smooth start-up on booster stations because diode limiter circuit eliminates reset wind-up.

No. 707T Electronic DP Transmitter (Left)

- Extremely reliable for unattended stations. Has no vacuum tubes, no transistors. Unaffected by vibration.
- Ideal for use where paraffin is present because nothing exposed to the process except end plates (steel or 316 stainless steel) and 316 stainless steel diaphragms.
- Can be used with reciprocating as well as centrifugal compressors because of internal silicone damping—continuously adjustable to damp out pulsations from 5 to 100 cpm.
- Cannot be damaged on remote station start-up because of full overrange protection to 1500 psi—either high or low sides.



No. 700J AC or DC Electronic Recorder (Left)

- Powerful servo motor provides accuracy of ½ of 1%, sensitivity to changes of 0.1% in input signal.
- Simplified tie-in of subsequent operations or auxiliary equipment permitted by operation of integral servo-operated alarms.
- Big 4" rectilinear chart gives 30 day record (1" per hour).
- Completely transistorized, unaffected by ±10% line voltage variation.

• • •

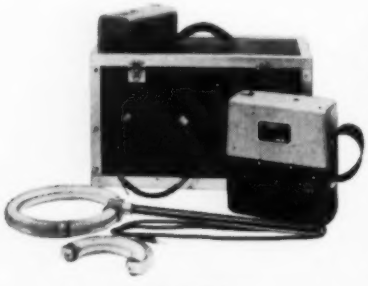
Call your Taylor Field Engineer, or write for appropriate bulletin.

Taylor Instrument Companies, Rochester, N.Y., or Toronto, Ont.

Taylor Instruments MEAN ACCURACY FIRST

FOUR WAYS TO INSURE GOOD COATING PROTECTION

Continuity is all important in a protective coating. Whether it's a 90 mil coating on a pipeline or a 3 mil coating on a chemical tank, a tiny pinhole can lead to the destruction of the coating. Use of a Tinker and Rasor Holiday Detector will quickly locate pinholes as well as weak spots caused by air bubbles, coke, rust or scale. Minutes spent inspecting with a Tinker and Rasor Holiday Detector while the job is open can save days of down time later on.



Pipeline Detectors

E-P For damp or dry surface, high electrical resistance coatings. Output adjustable from 8000 to 20,000 pulsating voltage. Electrodes available: half circle, spring for pipe to 6", full circle to 30" silicone brush for flat surfaces.

E-4 This lower cost type of detector is specifically designed for smaller diameter pipe and flat surfaces with dry surface, high electrical resistance coatings. Output adjustable from 8000 to 20,000 D.C. voltage.

Thin Film Detector

M-1 For painted or sprayed thin film coatings. Maximum applied voltage 67½ V., non-destructive to coatings. Belt mounted, 4 lbs. total wt.

Underground Pipeline Detector

P-D For detecting holidays, electrical contacts or locating the pipeline itself, **without uncovering the pipeline.** Completely transistorized—long life and light weight.

Engineering Note:

Every protective coating specification should include TR Holiday Detector inspection. Write for specification guide.

DISTRIBUTORS:

Falcon Line Products Corp., Kearny, New Jersey
Crutcher-Rolfs-Cummings, Inc., Houston, Texas
Remco Manufacturing Co. Inc., Tulsa, Oklahoma
Bob Herrick, New Cumberland, Pennsylvania
Canadian Equipment Sales & Service Co. Ltd., Edmonton, Alberta, Canada
Export Agent: Frazar & Hansen Ltd., San Francisco, Calif.

Write today for technical data and bulletin.

Quality Control for Coating Application

TR TINKER & RASOR

417 Agostino Road, P.O. Box 281 • San Gabriel, California

PROPOSED CONSTRUCTION

continued

Texas Eastern Transmission Corp., Shreveport, La., 212 miles, 20 to 36-inch, gas, and 3,300 hp station, in Pennsylvania, New Jersey, New York and Mississippi, $46 million, before FPC., contracts let to H. C. Price Co., Sharman Allen, Gay & Taylor, Inc., and Western Pipe Line, Inc.

66 miles, 30-inch, gas, loops, between Vidor, Texas and Lambertville, N. J., and 33,710 hp in four existing stations, $17.5 million, before FPC.

90 miles, LPG, Lebanon to Lima, Ohio, planned.

Extension of products line from Lebanon, Ohio, to Elmira, N.Y., considered.

350 miles, 24-inch, coal slurry, West Virginia to New York, considered.

Transcontinental Gas Pipe Line Corporation, Houston.

211 miles, 36-inch, and 69 miles, 30-inch, loops and additional 32,040 hp, in Texas, Louisiana, Mississippi, Alabama, Georgia and South Carolina, $52 million, before FPC.

13 miles, 24-inch and 18 miles, 20-inch loops, Louisiana, FPC authorization. 14 miles, 16-inch laterals, 1-mile, 12-inch lateral, Louisiana, $2.1 million, FPC authorization.

29 miles, 20-inch, gas, and 2,500 hp, in South Texas to take gas from South Texas Natural Gas Gathering Co., $2.4 million, before FPC.

Transwestern Pipeline Company, Houston, pipe line facilities to cost $5.4 million to make available additional gas reserves for the line presently under construction, before FPC.

Trunkline Gas Company, Houston, 252 miles, 30-inch loops, and 140 miles, laterals, between Longville, La., and Tuscola, Ill., $45 million, before FPC.

Underground Storage & Exploration, Upper Darby, Penn., 394 miles, 12-inch LPG, from Moundsville, W. Va. to Newark, N. J., $9 million, approved.

95 miles, 6-8 inch, laterals to Mauch Chunk, Penn., and to Philadelphia, planned.

United Gas Pipe Line Co., Shreveport, La., 59 miles, 36-inch, gas, lateral between Bastian Bay field and Plaquemines Parish, La., before FPC.

Valley Gas Transmission, Inc., Houston, 55 miles, 3 to 8-inch, gas, gathering, in Hidalgo, Brooks, Starr and Jim Wells counties, Texas, $15 million, before FPC.

International

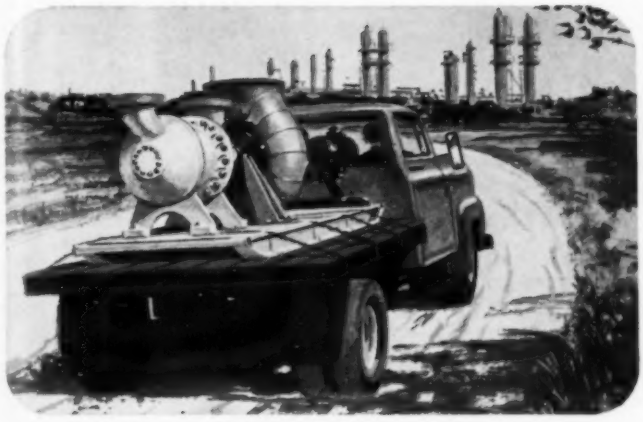
ACT Oils, Ltd., Montreal, 400 miles, crude, Dawson Creek, B. C., to Bella Coola, B. C., before B. C. government.

Ajax Alberta Pipeline Ltd., 28 miles, 10-inch, gas, main, Morinville to Westlock, Alta., planned.

Alberta Gas Trunk Line Company, 386 miles, 26-36-inch, gas, main, Berland River area, Alberta, to Alberta-British Columbia border; and 235 miles, 8-18-inch, gas, gathering, Alberta, $100 million, Alberta Oil and Gas Conservation Board, approved.

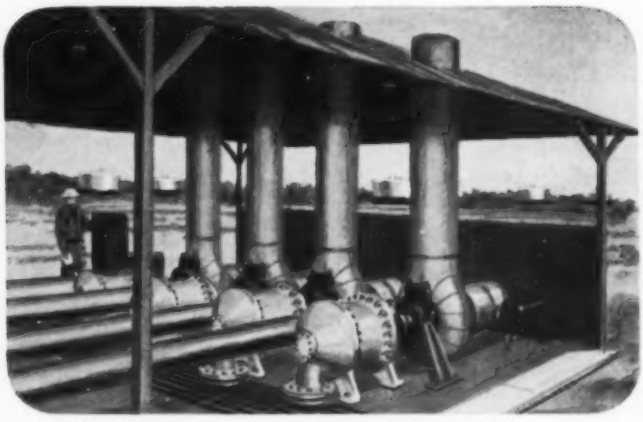
Continued on Page 64

Petroleum industry benefits with Solar turbomachinery



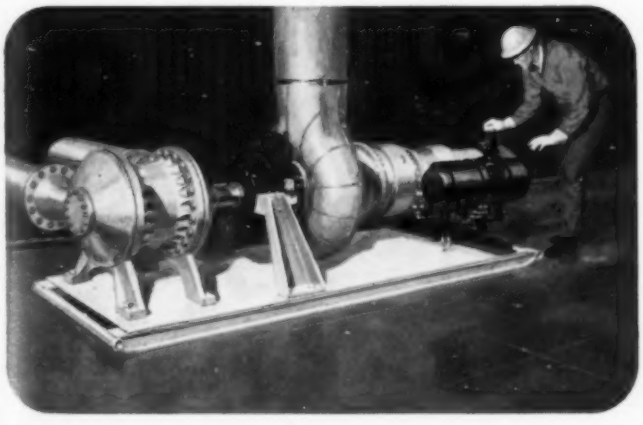
1. Easily transported

Because they are smaller and lighter than conventional power plants, Solar gas turbines are easily transported for original installation, or to a central shop for periodic maintenance. And the basic power plants, or generator sets, compressor units, and similar applications, can be inexpensively adapted for portable use.



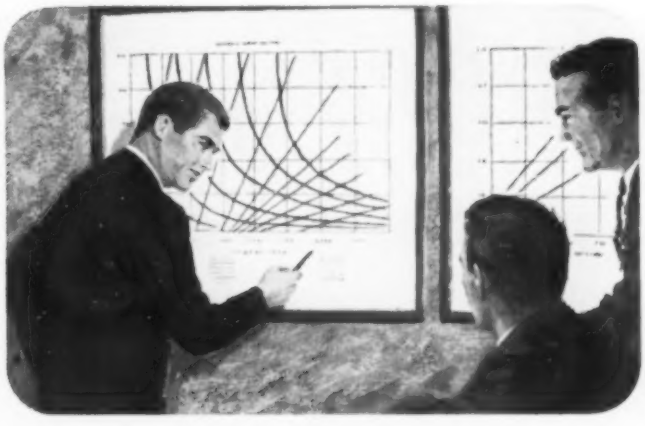
2. Low cost installation

The same light weight and small size that makes transportation simple, also cuts the cost of installing Solar gas turbines and turbomachinery. Minimum vibration makes possible skid mounting or the use of present light foundations – you avoid heavy construction costs and install these units quickly without special labor requirements.



3. Simple maintenance

Solar gas turbines are simple in design, with few moving parts. They are easier to maintain than diesel or gasoline engines. Down time is cut to a minimum. Features such as interchangeable compressor wheels in Solar compressor units make quick field changes possible. Solar turbomachinery is designed for long, trouble-free life.



4. Low over-all cost

Whether you consider the capital cost of installed horsepower, or operating and service costs per installed horsepower, you will be pleasantly surprised when you measure Solar gas turbines against competing installations. We'll furnish the facts and figures you need on request. Solar builds turbines and turbomachinery to rugged industrial standards, for electrical power generation, gas compression, pumping, boat and vehicle propulsion, and for many special applications. Solar gas turbines range in size from 50 to 1250 hp.

You should investigate the profitable use of Solar gas turbines and turbomachinery. Write to Solar Aircraft Company, Dept. H-136, San Diego 12, Calif., for brochures or for information about specific applications.

SOLAR
AIRCRAFT COMPANY

PROPOSED CONSTRUCTION

continued

Alberta Natural Gas Company (Jointly owned by Westcoast Transmission Co. and Alberta & Southern Gas Co. Ltd.) 110 miles, 36-inch, gas, Alberta border to British Columbia-Idaho border, supply gas to Pacific Gas & Electric Co., $40 million, planned.

Arabian American Oil Company, New York, 73 miles, 30-inch, crude, from Khursaniyah station to Ras Tanura, under way.

Barnabos Group (Italian Interests), crude line from Venice, Italy, to Insbruck, Austria, with extension to Munich, Germany, planned.

Bituminous Oil Pipeline Co., Calgary, 250 miles, crude, from Athabasca tar sand plant in northeastern Alberta to Edmonton, approved.

Brazilian Government, Rio de Janeiro, 300 miles, 12-inch, crude, Rio de Janeiro to Belo Horizonte, planned.

British American Oil Co., Ltd., Toronto, 125 miles, gas, Pincher Creek fields to Calgary, Alta., before Alberta Public Utilities Board.

Burmah Oil Co., Ltd., 850 miles, crude, 20 inch, from Nahorkatiya to Calcutta, India.

Cartier Gas Corp. (St. Maurice Gas, Inc., and Consumers Gas Co., Toronto), 170 miles, gas, Montreal to Quebec City, planned.

Consolidated Gathering Systems, Ltd., Calgary, 198 miles, crude, Sturgeon field to Edmonton, planned.

Creole Petroleum Co., 44 miles, 12-30-inch, gas, Bachaquero to Tia Juana, Venezuela, planned.

Esso Standard Libya, 100 miles, 30-inch, crude, Zeltan oil field to Gulf of Sirte coast, planned.

Foothills Pipe Lines Ltd., 1,300 miles, LPG, from Alberta-Saskatchewan border to Chicago, tie-in with Westalta Products Pipeline proposed system in Alberta, $100 million, before Alberta Board of Public Utilities Commissioners.

Gas Trunk Line of British Columbia, Vancouver, 250 miles, 30-inch, gas, main, Fort Nelson to Taylor, B. C., planned.

Gases Naturales de Colombia, S.A., 140-mile, 10-inch, gas, Cicuco field to Barranquilla, Colombia, planned.

Hughenden Pipeline, 125 miles, products, Dick Lake gasoline plant to Hughenden Region, Alta., planned.

Hydrocarbons Pipeline, Ltd., Winnipeg, Manitoba, 880 miles, 6-8 inch, products, from Edmonton to Winnipeg, $35 million, partial authorization.

Independent Pipe Line Co., 2,019 miles, 34-36-inch, crude, Edmonton to Montreal, 23,000 pump horsepower, $395 million, before Borden Commission.

Interprovincial Pipe Line Company, 350-mile extension from Toronto to Montreal, looping line from Edmonton to Toronto, crude, $240 million, considered.

Additional horsepower in four new stations and several existing stations, $9.3 million, planned.

Island Transmission Company Limited, Nanaimo, B.C., 25 miles, 10-inch, gas, from point near Vancouver, B.C. to Vancouver Island, 67 miles, 10-inch, laterals to Victoria and Nanaimo, B.C., $14 million, appeal before British Columbia Public Utilities Commission.

Magna Pipeline Co., 25 miles, 4-inch, gas, Vancouver, B.C. to Vancouver Island, $14 million, approved by Public Utilities Commission over Island Transmission Co. proposal.

Mid-Continent Pipe Lines, Ltd., 1500-mile, 30-inch crude, Edmonton to Chicago, planned.

Naphtha Israel Oil Co., 75 miles, 6-inch, gas, Rosh-Zohar field to Ashdod Yam on Mediterranean planned.

National Iranian Oil Co., 146 miles, 6 inch, crude, from Azna to Isfahan, Iran, $5 million, planned.

500 miles, 8-inch, products, Teheran to Meshed, Iran, contract let on 250 miles to Williams Bros. Co.

Northern Alberta Pipe Lines, Ltd., Edmonton, Alta., 110 miles, 10-inch, gas, main, Lac La Biche to Edmonton, $3 million, planned.

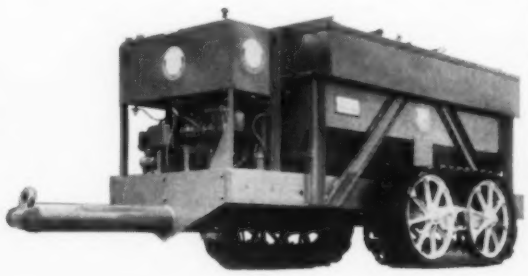
Continued on Page 66

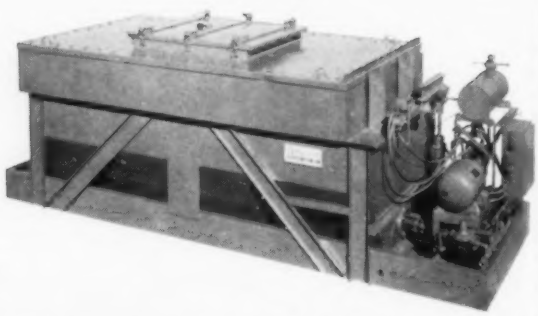
CROSE-LITTLEFORD
PIPELINE KETTLES

WITH MORE FEATURES FOR SPEED AND EFFICIENCY

- SWEEP ARM AGITATOR HYDRAULICALLY DRIVEN
- SELF-THAWING DRAW-OFF VALVE
- LOW CENTER OF GRAVITY
- LARGE CAPACITY
- EXTRA LARGE LOADING DOOR
- INSULATION
- UNITIZED CONSTRUCTION
- BURNER — Safe, low pressure type.
- POWER UNIT — Self-starting air cooled engine.

CROSE-LITTLEFORD PIPELINE KETTLES ARE AVAILABLE IN THREE SIZES: 10-BARREL, 23-BARREL, OR 30-BARREL CAPACITY. ALSO, 75-GAL., 165-GAL., 225-GAL., AND 325-GAL. PATCH KETTLES AVAILABLE.





NEW SKID-MOUNTED KETTLE FOR STATIONARY YARD WORK
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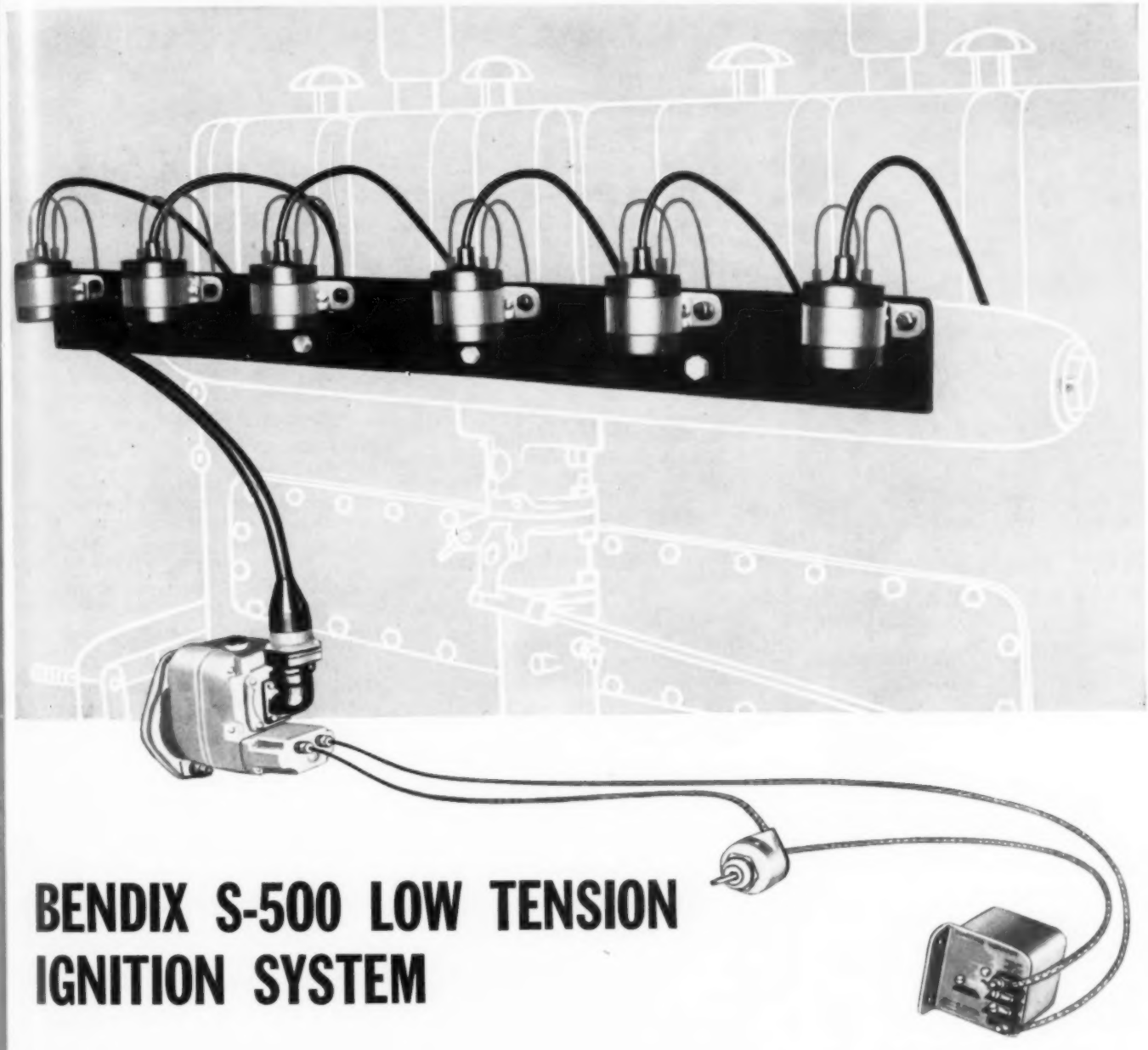
The latest for small-to-medium industrial engines



BENDIX S-500 LOW TENSION IGNITION SYSTEM

The S-500 System provides the ultimate in starting and operating efficiency for your four, six, and eight cylinder industrial engines. Specify the new Bendix™ S-500 Low Tension Ignition System. It features "the modern starting concept"—retard breaker magneto and starting vibrator system.

This complete Low Tension Ignition System—including transformer coils, wiring cable assembly, starting vibrator, ignition and starting control switch, and retard breaker magneto—is custom-engineered to assure positive ignition at all cranking speeds and varied retard requirements. It is furnished in base or flange mounting, flameproof and radio shielded, is adaptable for manual or automatically controlled installations.

(TM—Trademark)

The S-500 Series, either base or flange mounted, is supplied with the following features:

S-500 Standard Shielding, adjustable drive assembly.
S-501 Standard Shielding, adjustable impulse coupling.
S-502 Super-shielded, adjustable drive assembly.
S-503 Super-shielded, adjustable impulse coupling.
S-504 Standard Shielding, retard breaker, adjustable drive.
S-505 Super-shielded, retard breaker, adjustable drive.

For additional information concerning the best Bendix Ignition System for your particular engine requirements, write:

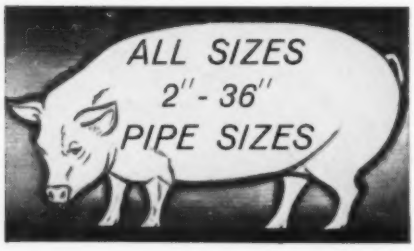
Scintilla Division
SIDNEY, NEW YORK

THE Bendix CORPORATION

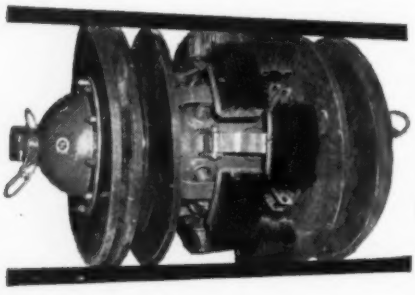
Export Sales & Service: Bendix International, 205 E. 42nd St., New York 17, N. Y.

For more data on advertised products, use Readers' Service Cards, last page.

MYOCO PIPELINE PIGS



ANY COMBINATION ALWAYS IN STOCK



MYOCO S-18 COLLAPSIBLE PIG

Especially designed for use on dual diameter lines and lines with small I. D. full opening valves within collapsible range. Sturdily built of lightweight aluminum castings with spring loaded brushes and collapsible rubber discs, the S-18 assures maximum cleaning action.

COLLAPSIBLE SIZES: 36" to 30", 30" to 24", 24" to 20" and 20" to 18".

MORRIS-YOUNG-OWENS CO.

PIPELINE EQUIPMENT AND SUPPLIES

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PArkview 3-0110
In Canada: MYOCO LIMITED, Rural Route 1, Midland Ave. N., Agincourt, Ontario, Canada
Tel. AX 3-1211

Northern Pipe Line Company, 153 miles, 16-inch, crude, from Regina, Saskatchewan, to Clearbrook, Minn., $10 million, planned.

Oasis Oil Co. of Libya, 100 miles, 30-inch, crude, Libyan production to Mediterranean, planned.

Peace River Oil Pipe Line Co., Ltd., 70-mile, crude, Swan Hills to Iosegun Junction, approved.

230 miles, 8-inch, crude gathering, from fields in northeast British Columbia to Dawson Creek, B. C., and Grande Prairie, Alta., and to existing lines at Sturgeon Lake, $8.5 million, authorized.

Pembina Pipe Line, Ltd., Edmonton, 1,200 miles, LPG, from Alberta gas fields to eastern Canada, planned.

Petroleos Mexicanos, 4, 6 and 8-inch, products, Mexico City-Puebla to Cuernavaca, planned.

8-inch, products, and 12-inch, gas Torreon to Chihuahua, to be built in 1960.

360 mile, 12-inch, products, Minatitlan to Puebla and Mexico City, construction to start in 1960.

Products, Guadalajara to Tepic, planned.

Products, Aguascalientes to Zacatecas, planned.

6-inch, products, Guaymas to Ciudad Obregon, considered.

8-inch products, Guaymas to Hermosillo, considered.

8-inch, gas, Tierra Blanca to Veracruz, to be built in 1960.

14-inch, gas, Mexico City to Salamanca, construction to start in 1960.

Gas, Ciudad Carmen to Ciudad Pemex.

8-inch, crude Comalcalco to Minatitlan, to be built in 1960.

Crude, Minatitlan to Salina Cruz, contingent on proposed refinery on Pacific Coast.

149 miles, 10-inch, products, Ciudad Pemex to Minatitlan, planned.

181 miles, 4-inch, products, Mexico City to Salamanca, planned.

Pipelines of Puerto Rico, Inc., 95 miles, 8-inch, products, Penuelas to San Juan, Puerto Rico, approved.

Quebec Gas Transmission Lines, Inc., Montreal, 300 miles, gas, main, Quebec to Montreal, planned.

Rangeland Pipe Line Company Limited, 111 miles, 8-inch, crude, southeastern Alberta to Calgary, $3 million, planned.

Saskatchewan Power Corp., 179 miles, 4-6-8-inch, gas, planned.

Societa Nazionale Metanodotti, 650 miles, 18-inch, crude, Genoa, to Milan-Cremona-Torino, Italy, and Aigle, Switzerland, with extensions to Karlsruhe and Munich, Germany, planned.

Societe d'Etude du Pipe Line Sud-European, Paris, 419 miles, 30-inch, crude, port of Lavera to Strasbourg, with lateral extending 40 miles to Karlsruhe, Germany, approved by French cabinet.

Soc. Siciliana Metanadotti, gas line from Hassi R'Mel field in Algeria through Tunisia, across Mediterranean to Sicily and into Italy, considered.

Standard-Vacuum Oil Company, 60 miles, 8-inch, gas, main, in South Sumatra, considered.

Ste. d-Etudes de Pipeline Intercontinetaux, Paris, 1,400 miles, 30-40-inch, gas, from Hassi R'Mel field in central Algeria across Mediterranean, through Spain, France and into West Germany, considered, Fish International Corporation making engineering and feasibility studies.

Sui Gas Transmission Co., Multan, Punjab, India, 145 miles, 8-inch, gas, from Sylhet to Dacca, East Pakistan, $9 million, considered.

130 miles, 16-inch, gas, main line, Multan to Lyallpur, planned.

Syrian Pipeline, Damascus, 500 miles, crude, from Karshuk field, Syria to Mediterranean, planned.

300 miles, products, from Homs to tank farms in Damascus, Aleppo and Latakia, planned.

Trans-Canada Pipe Lines Limited, Toronto, 50-mile, 30-inch, gas, lateral, Winnipeg to Emerson, Manitoba; 74 miles, 34-inch, loops, additional compressor hp at Swift Current, and Indian Head, Saskatchewan, and Portage la Prairie, Manitoba, $45 million, planned.

268 miles, 34-inch, loops, and additional hp planned for 1961, $69 million.

122 miles, 34-inch, loops, hp additions, $46 million, planned for 1962.

Trans-Prairie Pipelines, Ltd., Edmonton, crude line, from Weyburn field to Regina-Moose Jaw areas, $5 million, considered.

Westalta Products Pipeline Ltd., 900 miles, LPG, from Northern Alberta to Saskatchewan border, to deliver hydrocarbons to Foothills Pipe Lines, $40 million, before Alberta Board of Public Utilities Commissioners.

Williams-McWilliams Industries, Inc., New York, 441 miles, 6-inch, crude, Villa Montes, Bolivia to Villa Hayes, Paraguay, considered.

CLASSIFIED ADVERTISING

Pipe Line Specialist with Instrumentation Background

Rochester-based sales promotional man to direct sales efforts in pipe line field.

Requirements: Graduate engineer, preferably electrical but not imperative. Must know the pipe line industry and have experience with pipe line instrumentation.

Qualified applicants should send resume* to Personnel Director

Taylor Instrument Companies

95 Ames Street Rochester 1, N. Y.

* All applications will be treated confidentially.

ON THE LINE

Cooking With Gas

According to American Association reports home-heating customers advanced to an all-time high of 20.2 million in 1959, up 6 percent from the previous year.

While 1,159,000 heating customers were added in 1959, the AGA forecasts that nearly 4 million more customers will be heating with gas by the end of 1962. The survey shows 66.7 percent of the industry's residential customers heat with gas, up from 64.9 percent a year earlier. The new figures represent 81.2 percent of potential attainable saturation of house-heating among existing gas customers.

Transportation Survey

A nation-wide survey of transportation education in 2,000 American colleges and universities is being undertaken by the Transportation Center at Northwestern University.

Survey's purpose is to put into one publication a brief description of transportation education programs of American colleges and universities.

Questionnaires will ask for information on undergraduates, graduate, and in-service transportation training during the 1959-60 and 1960-61 academic years. Results will be made available to industry executive, educators and students.

Education Grants

Standard Oil Foundation, Inc., announces a $175,000 grant for education to be distributed among 159 privately financed liberal arts colleges with an enrollment of 130,000 students in 13 Midwest states.

Funds are granted to member colleges by each state association in Colorado, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Montana, Nebraska, North Dakota, South Dakota and Wisconsin.

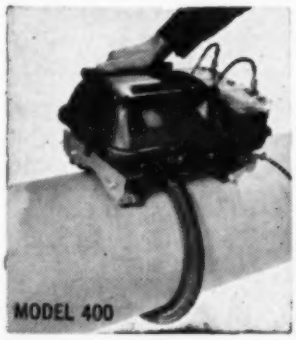
No restrictions are placed on use of the funds as long as they are spent for the education program.

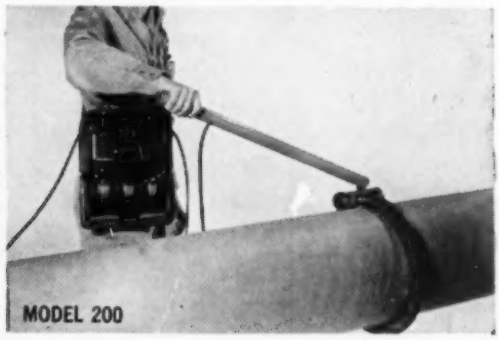
Spy Detector

QUALITY SERVICE

is there . . . when you need it!

...our SPY HOLIDAY DETECTORS are as near as your telephone—in fact, in emergencies our own plane assures immediate service.





Rugged equipment for dependable holiday detection on ¾" to 36" pipe...signal—bell, light and spark...unaffected by dew or frost.

Call, wire or write.

Pipeline Inspection Co., Inc.

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Another benefit of an Oakite ECP*

One new liquid cleaner does many jobs

OAKITE 202—a new, all-purpose liquid cleaner—is up-to-date proof of just how an Oakite ECP pinpoints the latest research results... gives you more efficient cleaning at less cost.

Whether you spray, mop or brush it on, Oakite 202 is packed with cleaning power. Even when liberally diluted with water, Oakite 202 produces a sudsy solution that cuts fast through grease, grime, caked-on deposits. Yet, it's safe for painted surfaces and fine for brightening up equipment, piping . . . floors, too.

** OAKITE ECP is a detailed Engineered Cleaning Program developed to fit your particular operation under the experienced supervision of your local Oakite man. ECP covers all your cleaning needs.*

For more details write Oakite Products, Inc., 47A Rector Street, New York 6, N. Y.

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over 50 years' leadership in industrial cleaning — Est. 1909 — SCIENCE

On the Job with Bethlehem Line Pipe

IN VENEZUELA—Forty-inch line pipe—some 12 miles of it—now lies as deep as 100 feet under the surface of Lake Maracaibo, helping to supply gas to one of Creole Petroleum Corporation's re-injection systems. The pipe was made by Bethlehem and supplied to the contractor, Brown & Root, Inc., in 40-ft lengths, each of which, when weighted with a 6-in. coat of mesh-reinforced concrete, tipped the scales at nearly twenty tons.

Steel

For strength
... economy
... versatility

	ELECTRIC FUSION-WELD	ELECTRIC RESISTANCE-WELD	CONTINUOUS BUTTWELD
SIZES (in., OD, incl.)	18 to 42	5⅝ to 16	½ to 4½
WALL THICK-NESS (in.)	¼ to ¾ incl.	API	API
LENGTHS	40 ft★	to 60 ft	SRL 24 to 26 ft DRL to 50 ft
SPECIFI-CATIONS	API 5LX, Grades X42, X46 & X52 Also X-56	API 5L, Grades A & B API 5LX, Grades X42 & X46	API 5L

★Made with 40-ft plates; submerged-arc-welded; hydraulically, expanded.

Bethlehem's new pipe mills at Steelton, Pa., and at Sparrows Point, Md., are turning out more pipe than ever before. And it's pipe of consistent top-quality, too—every length straight and true to round and bevel, and right up to specs.

It's easy to check all the facts about Bethlehem Line Pipe—just call the Bethlehem sales office nearest you.

IN PENNSYLVANIA—New gas service was brought into Carbon County recently when the Pennsylvania Gas Management Co. ran an 8-in. line to Lehighton from Transco's 24-in. main line at Saylorsburg. In spite of the winter and the rough terrain, McKenzie Construction Co., Inc. had no trouble laying the Bethlehem electric resistance-weld pipe. As supplied by C. J. Rainear & Company, Inc., the pipe measured up to specs in every way.

IN ARKANSAS—The latest addition to Arkansas-Louisiana Gas Company's extensive pipeline system is a 100-mile, 16-in. OD transmission line running across the summit of Magazine Mountain, the highest peak in Arkansas. The Bethlehem pipe in this line was furnished in .250-in. wall to API 5LX, Grade X-46 specification, and is now carrying pressures up to 1000 psi.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

Festival of Flame

More than 200 of the newest and most significant technical developments in gas industry will highlight the "Festival of Flame" exhibit at the American Gas Association's forty-second annual convention October 9-12, in Atlantic City.

Centerpiece of the exhibit will be a spectacular 30,000 square foot mall-type educational display arranged by AGA operating section. Exhibitors will show the newest and most important equipment and control devices used in every area of gas operations, from well-head to the customer's burners.

Chairman of the exhibit planning committee Christy Payne, Jr., Consolidated Natural Gas System, reports that some 100 new developments by nearly 50 manufacturers and gas companies already have been qualified and signed for display.

PEMCO

The PIPELINER'S SUPPLY STORE

Sales and rental on supplies and equipment for all pipe line CONSTRUCTION and REPAIR PROJECTS

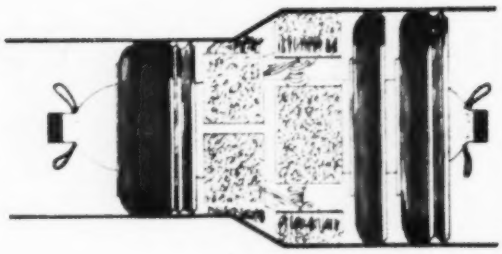
PEMCO Hot Dope Kettles

PEMCO Cleaning-coating-wrapping machines

Precision pipe reforming clamps

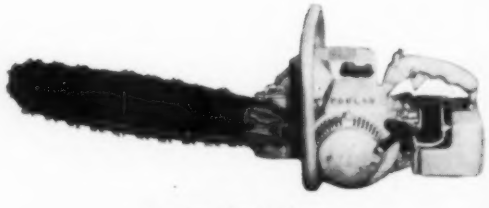
PEMCO COLLAPSIBLE PIGS

For cleaning gas lines, new construction and on stream running. Will traverse 45° and 30° factory ells and cold field bends 36" to 30"; 30" to 24"; 24" to 18". Also 36" Line Runs w/valves 30" size; 30" Line Runs w/valves 24" size; 24" Line Runs w/valves 18" size.



PORTABLE TOOLS

Line up clamps, shovels, felt-glass wrap, Kohler Light Plants, beveling machines, wrenches.



Poulan Chain Saws

PIPELINER'S EQUIPMENT MANUFACTURING CORP.

2525 MAGNET STREET, HOUSTON, TEXAS

JA 6-2073

Stockholder Relations

Gas pipe line companies have always been proud of their compressor stations, which, as a rule, are shiny, spotless and a prime example of good housekeeping. Texas Eastern Transmission Corporation is even proud enough of its installations to invite stockholders to take a good look at any or all of them.

In its spring issue of the company magazine, *The Inch*, Texas Eastern invites stockholders and families to visit any station(s) that they might be near while traveling on vacation this summer. *The Inch* included a list of all 61 station locations and provided a form for potential visitors to fill out for necessary information in advance of their visits.

This is one of the best ways to show a pipe line company's physical strength as well as allow stockholders to get better acquainted with operations of the system in which he is investing. Seeing modern gas turbines, electric motors, and reciprocating engines driving large compressors is an impressive sight.

Such visits should bring about better stockholder-company relations.

Burning Bright

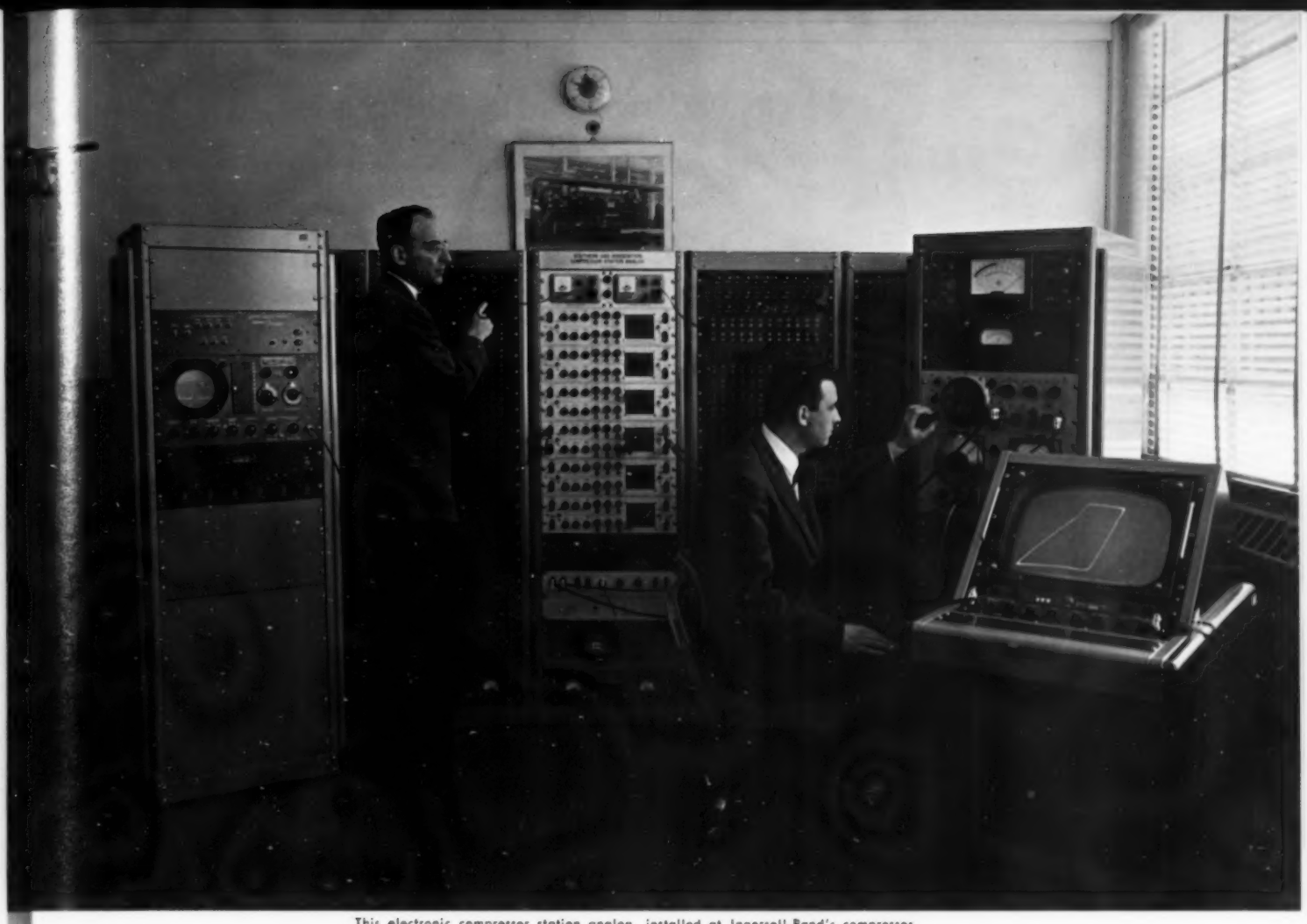
Two U.S. Army helicopters with three-men crews were caught in a snow storm near Russellville, Ky., while on a routine flight to Fort Knox, Ky., around midnight.

Looking desperately for a landing strip or an open field to land the craft, pilots circled above Russellville trying to pick up a trace of light through the blinding snow.

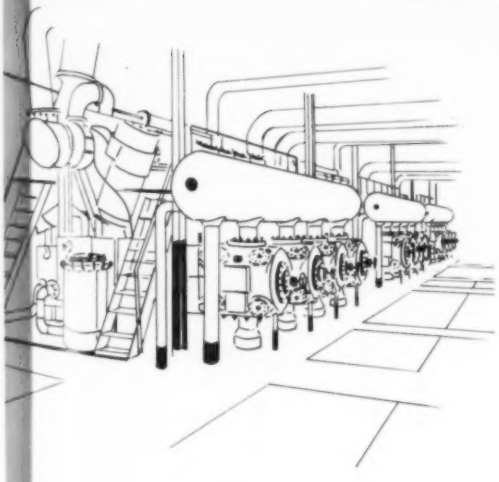
Finally pilots Lt. Samuel Childs and Lt. Clayton L. Davis spotted what looked like a well lit temporary landing strip and the airmen guided the helicopters to safety landing in the field adjacent to the lights.

What the pilots learned next was that they had landed in the Rockwell Manufacturing Company parking lot which is always well illuminated with gas lights. These gas lights and a neon sign over a restaurant were the only light visible through the heavy snow.

In the April issue of Rockwell's *Flow Line*, the pilots explain how they felt about the gas light beacon. "We believe," said Lt. Childs, "that the gas lights saved our lives and the two helicopters."



This electronic compressor station analog, installed at Ingersoll-Rand's compressor and engine plant in Painted Post, N. Y., is now in use for piping analysis.



Taking the PULSATIONS out of a pipeline station

If you've ever seen compressor manifolds and piping resonate like an organ pipe, you know that gas pulsations can create serious problems which are costly and time-consuming to correct. But this evidence isn't always present to warn of piping troubles—the pulsations may be too small to shake the pipes, but still cause poor compressor performance.

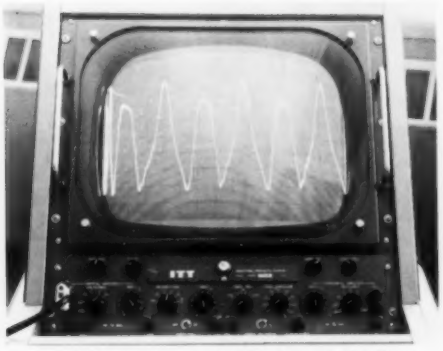
It involves long, complex calculations, by conventional methods, to design optimum manifold and piping arrangements for any compressor installation.

But now Ingersoll-Rand has taken the headaches and guesswork out of piping specifications, with the installation of a new "compressor station analog"—the most modern, most precise unit of its type in the world. By setting up an electronic simulation (or analogy) of any compressor installation, pulsation patterns and their effects can be predicted and measured with higher speed and accuracy than before possible.

(continued overleaf)

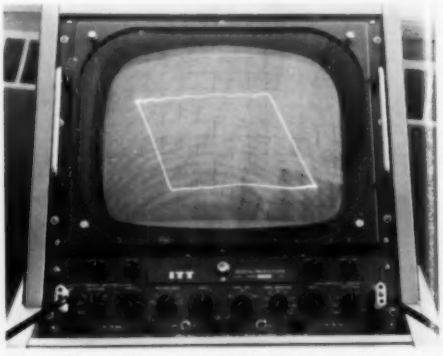
Ingersoll-Rand

How Ingersoll-Rand's **Compressor Station Analog** can prevent piping problems for you



This screen shows the pulsations which will occur at a selected point in a proposed compressor manifold and piping arrangement, indicating that changes should be made to prevent trouble.

The irregular indicator card pattern on this screen shows that pulsations in the system under analysis will cut down the efficiency of the compressor.



Here, using a corrected piping arrangement, the harmful effects of pulsation have been entirely eliminated, resulting in the correct pattern for top efficiency.

(see overleaf)

Designed and built especially for Ingersoll-Rand by the Southwest Research Institute of San Antonio, Texas, this electronic compressor station analog incorporates all the latest improvements which have been developed from experience with equipment previously supplied.

In operation, an electronic "model" of the compressor and its manifolds and piping is set up on the analog by means of plug-in components. Electric current is analogous to gas flow, and voltage is analogous to pressure. Compressor valves are simulated by diode tubes. Up to six cylinders may be simulated in any possible phase relationship, and any piping configuration may be set up for study.

On a calibrated oscilloscope screen, a visual pattern represents pressure waves taken from any point in the system. Another instrument makes a harmonic analysis of pressure variations and shows the size and frequency of each component. Indicator card diagrams of conditions inside the compressor cylinder may also be shown on a screen, for analysis of pulsation effects on compressor performance. Permanent records may be made by a camera attached to the analog. Various piping arrangements may be quickly tried on the analog to predict any faults, thereby preventing costly mistakes with the actual installation.

This analog has been made available solely for the benefit of Ingersoll-Rand's customers. In addition to *avoiding* problems on new installations, it can *diagnose* troubles in operating installations and permit quick remedy at minimum cost.

To take advantage of these facilities, get in touch with your Ingersoll-Rand engineer. You'll find him always ready to help with your other compression problems, too.

Ingersoll-Rand
11 Broadway, New York 4, N.Y.

The World's Most Comprehensive Compressor Experience

What's Happening

among MEN in the INDUSTRY

Douglas S. Estes has been appointed assistant to the general manager for **Kaneb Pipe Line Company.** He will be located at the Kaneb operating headquarters in El Dorado, Kan.

Estes formerly had been manager of industrial and public relations for Texas City Refining, Inc. During his 12 years in Texas City and LaMarque, Texas, Estes was associated with the Texas City Chamber of Commerce, Kiwanis Club, Galveston County Heart Association, Red Cross and several other civic and professional societies.

Northern Natural Gas Company announces the appointments of three men to the newly created position of gas buyer. **C. James Bulla, James P. Coyle** and **Richard L. Torczon** formerly were in the Gas Purchase Division of Northern Natural.

Bulla has been with the company since 1952, and was a staff assistant prior to his promotion. Coyle, who joined Northern in 1946, and Torczon, who has been with the company since 1947, were gas purchase engineers.

R. G. Kenan

W. S. Tarver

Mortimer Jordan

L. N. Brown

Southern Natural Gas Company announces the appointments of four executives to vice presidency and promotion of four vice presidents to senior vice presidents.

H. M. Erskine, H. E. Jackson, John M. Starke and **O. W. Clark** have been named senior vice presidents. **William S. Tarver, L. N. Brown, Robert G. Kenan** and **Mortimer Jordan** were elected vice presidents. **Howard Maxton** becomes assistant treasurer.

Jackson, Clark, Tarver, Brown, Kenan and Jordan are headquartered in Birmingham, Ala. Erskine and Maxton are located in the New York office, and Starke is in Houston as supervisor of the oil and gas and gas supply division. Erskine is financial vice president; Jackson continues as treasurer, and Clark remains supervisor of operations and engineering.

Tarver also will have the title of general attorney and secretary; Brown is also chief engineer; Kenan is director of industrial relations and insurance, and Jordan is director of public relations and industrial development.

John A. McGuire, president of **Three States Natural Gas Company,** has been named to the newly-created position of chairman of the board. **William H. Hudson** will succeed him as president. **Lee Van Atta** a vice president, has been named to the board of directors.

McGuire had been president since 1952. Hudson has been with the company as a director and vice president for five years.

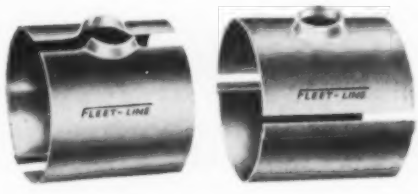
LESCHEN WIRE PORTER ROPE DIVISION
H. K. PORTER COMPANY, INC.

FLEET-LINE
WELDING FITTINGS
•
LITERATURE BY AIR MAIL...
...ask for it now.

REDUCERS: Concentric and eccentric. Nominal pipe sizes 1" to 30", ASA B16.9, ASTM A234. Schedules 10 to 160, stainless steel, and other alloys. Special lengths and sizes.

SADDLES: Conventional, and for pressure vessel heads. Nozzle sizes from ¼" to 24". Fleet-Line saddles weld neatly into place in much less time, and with much less welding rod.

Full encirclement saddles.



REDUCING TEES, Forged Steel Manifold Type.

Dealers and Stocking Distributors throughout the United States and Canada.

All orders acknowledged by air mail or long distance telephone and filled at once.

STEEL FORGINGS, Inc.

P. O. Box 276K • Shreveport, La.

For more data on advertised products, use Readers' Service Cards, last page.

NATIONAL SAFETY COUNCIL
AWARD OF MERIT
presented to
Houston Contracting Company
Pipeline Operations
for
A NOTEWORTHY
SAFETY PERFORMANCE
1959
Howard Pyle
It is well recognized that an organization's safety record is indicative of its over-all operating efficiency.
HOUSTON
CONTRACTING COMPANY
2807 BUFFALO SPEEDWAY
HOUSTON 6, TEXAS
R. P. Gregory
H. J. Muckley
E. C. Norris
Geo. A. Peterkin
OIL • GAS • PRODUCTS
WATER PIPELINES

Tom **Hopson**, former engineer, electrical section in Tulsa for **Service Pipe Line Company**, replaces **J. C. Peard** as an engineer in the East Texas division. He will be headquartered in Fort Worth, and Peard has been moved to Baytown, Texas.

The Controllers Institute of America has elected **W. D. Walser**, vice president of **Tennessee Gas Transmission Company**, a director.

Walser was selected at the organization's annual meeting in May at Louisville, Ky. He has been active in the Institute since 1953, and was president of its Houston Control in 1957-58. He will serve as general chairman of the association's 1961 Southern Area conference to be held in Houston.

Gilbert V. Rohleder has been named general superintendent in charge of operations for **Mid-America Pipeline Company.** Rohleder had been with Okan Pipeline Company for five years as vice president, operations. Previously he had been with Service Pipe Line Company for 10 years.

G. V. Rohleder

Rohleder is secretary and vice president-elect of the Pipeliners Club of Tulsa.

Lawrence C. Ford has been named president of the **California Shipping Company**, a **Standard Oil Company of California** subsidiary which manages the company's marine operations.

Lawrence succeeds **A. E. Kihn**, who retired after nearly 50 years service with the firm. Ford joined the parent company in 1938, and has held various managerial positions including superintendent of operations and assistant manager. He became vice president of the California Shipping Company when it was formed in 1957.

Albert L. Thompson has been promoted to crude oil purchasing and pipe line superintendent for **Lion Oil Division** of **Monsanto Chemical Company.**

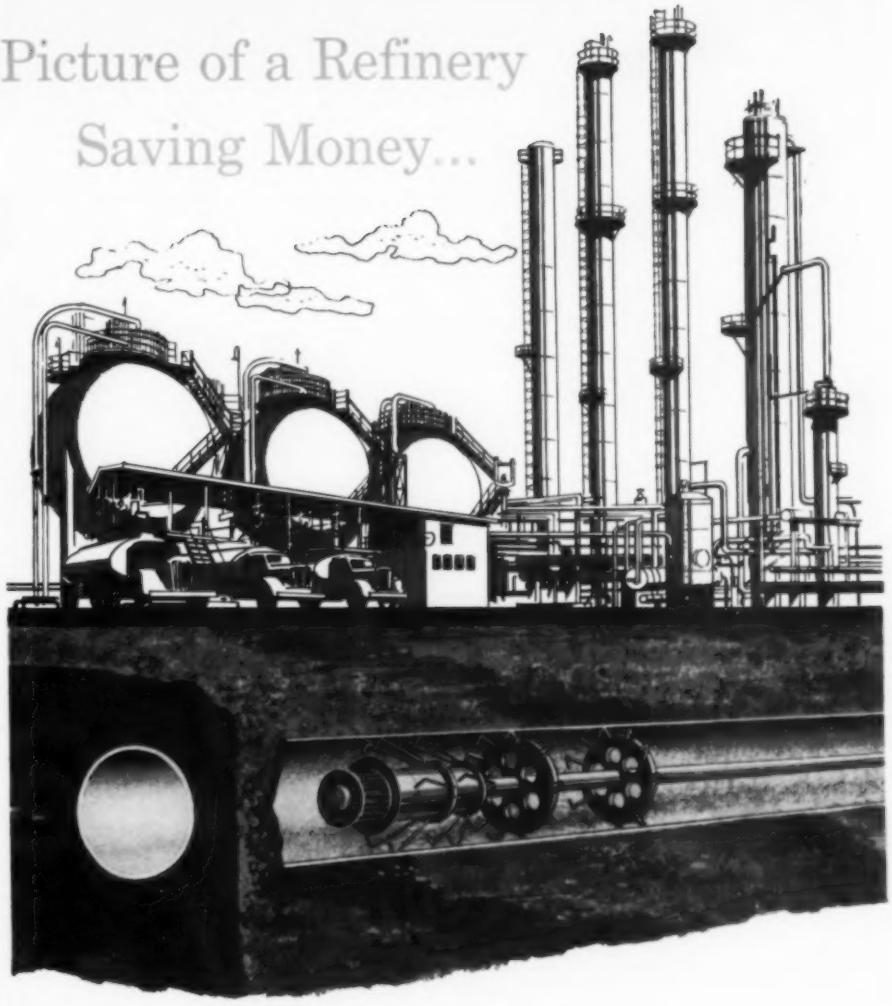
Thompson replaces **Rodney R. Landes** who has resigned. He has been with Lion since 1956, when he was named a junior engineer in Pipe Line Department. In 1957, he was appointed engineer.

A. J. Cressey has been appointed vice president in charge of heavy construction division and **O. Johanson** has been appointed vice president in charge of light construction division for **Banister Construction Company.**

Eric Fichtner becomes vice president, controller and secretary of the company. All three officers were appointed directors of the company.

Arthur D. Little, Inc., Midwest Division announces the relocation and expansion of its offices and laboratories. The Midwest Division, under management of **John R. Kirkpatrick**, is located at 130 North Franklin Street, Chicago.

Picture of a Refinery Saving Money...



Spunline Relines Pipe Lines in-place without removing the pipe

Another refinery, it could be in Texas, California or Montana, will soon be enjoying the savings of another rehabilitated pipe line. The flow will increase, the pumping cost will drop and the pipe line will be good as new for at least another quarter of a century.

And traffic will move without interruption or inconvenience to the public.

Spunline® is applicable to pipe lines down to 4" and may be used in cast iron, steel, concrete and wrought iron pipe lines.

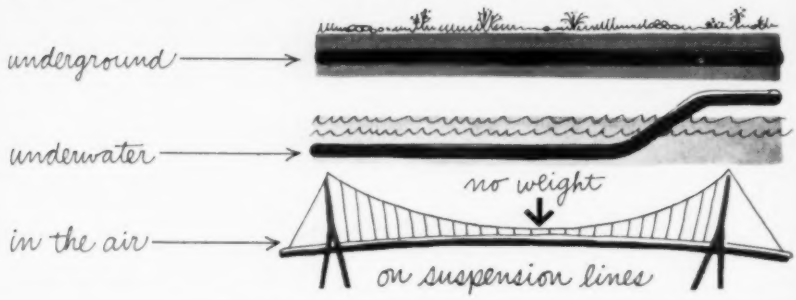
Write, wire or phone PIPE LININGS Inc.

Subsidiary of American Pipe and Construction Co.

2414 East 223rd Street, Wilmington, California
P.O. Box 457 • Phones: SPruce 5-3273 — TErminal 5-8201
Rail Address, Pacific Electric, Watson, California

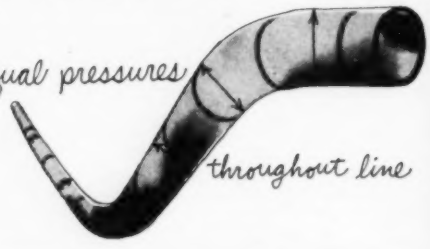
WORK FASTER, GET CLEANER JOBS—
TEST PIPELINES WITH COMPRESSED AIR

1 use Schramm rent-or-buy service for any line, anywhere



2 compressed air is clean, fast, dependable

Cuts set up time—lines are ready—instant air is released



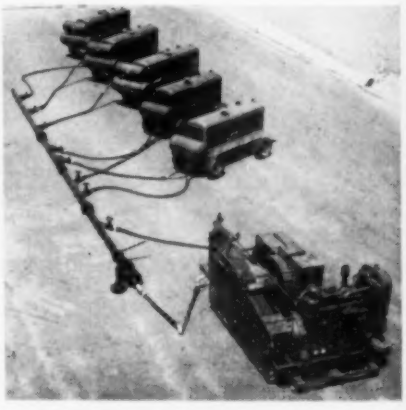
3 you eliminate

problem of water supply or disposal

no residue to clean out

4 Schramm has the complete package

three 600 cfm compressors
+ two 1-D booster units
+ one PPC booster unit
delivers 1635 cfm at 1500 psi
rental includes delivery to test site and experienced operator



Write for full information on purchase or rental of Schramm Pipeline Package.

Schramm AIR COMPRESSORS

740 North Garfield Ave., West Chester, Pa.

The **American Gas Association** announces the appointment of **Theodore I. Gradin** as director of the Bureau of Statistics. Gradin, who has been assistant director for the past two years, succeeds **Daniel Parsons,** who joined Northern Illinois Gas Co. as manager of rate and economic research.

T. I. Gradin

Gradin was named a junior statistician on the AGA staff in 1945, later advancing to assistant, associate and senior statistician. As assistant director of the Bureau his responsibilities included gas utility and pipe line rate analyses.

E. W. Bacharach, Inc., has become an affiliate of **J. F. Pritchard & Company.** Bacharach has been a contractor in the water conditioning field since 1922. **Eric W. Bacharach** will retain an interest and remain active in the organization as a consultant and a member of the board of directors.

Southern Union Gas Company named **A. M. Wiederkehr** vice president, exploration. He is in charge of the company's Land, Geological, Drilling and Production Departments. He joined the firm in 1952 as reservoir engineer and in 1954 was named to the Exploration Department.

Walter B. Oslund has been elected vice president and general manager of **Franklin County Coal Corporation,** subsidiary of Chemoil Industries, Inc. **Carl J. Hinz** has been promoted from dispatcher to assistant treasurer. Franklin County owns **Plains Pipe Line Co.**

W. C. McGee, president of **Tennessee Gas Pipeline Company,** was elected president of the Association of Former Students of Texas A & M College.

W. C. McGee, Jr.

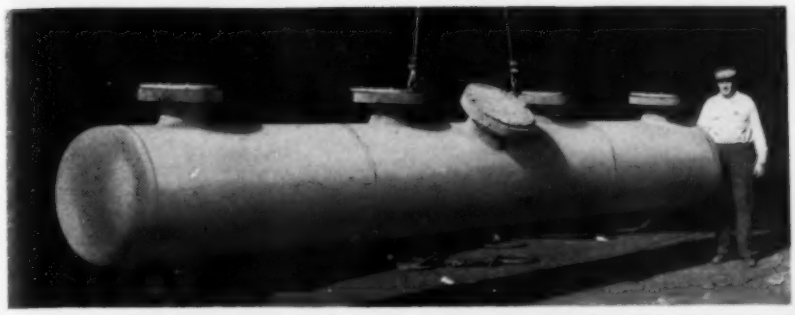
J. W. Aston of Dallas was named vice president at the meeting held at Texas A and M. Other alumni officials chosen from Houston include **Melvin Maltz,** district vice president; **O. Dooley Dawson,** member of board of trustees for student loan fund; **E. J. Mosher** and **Michel T. Halbouty,** representatives on the development fund board.

Deaths

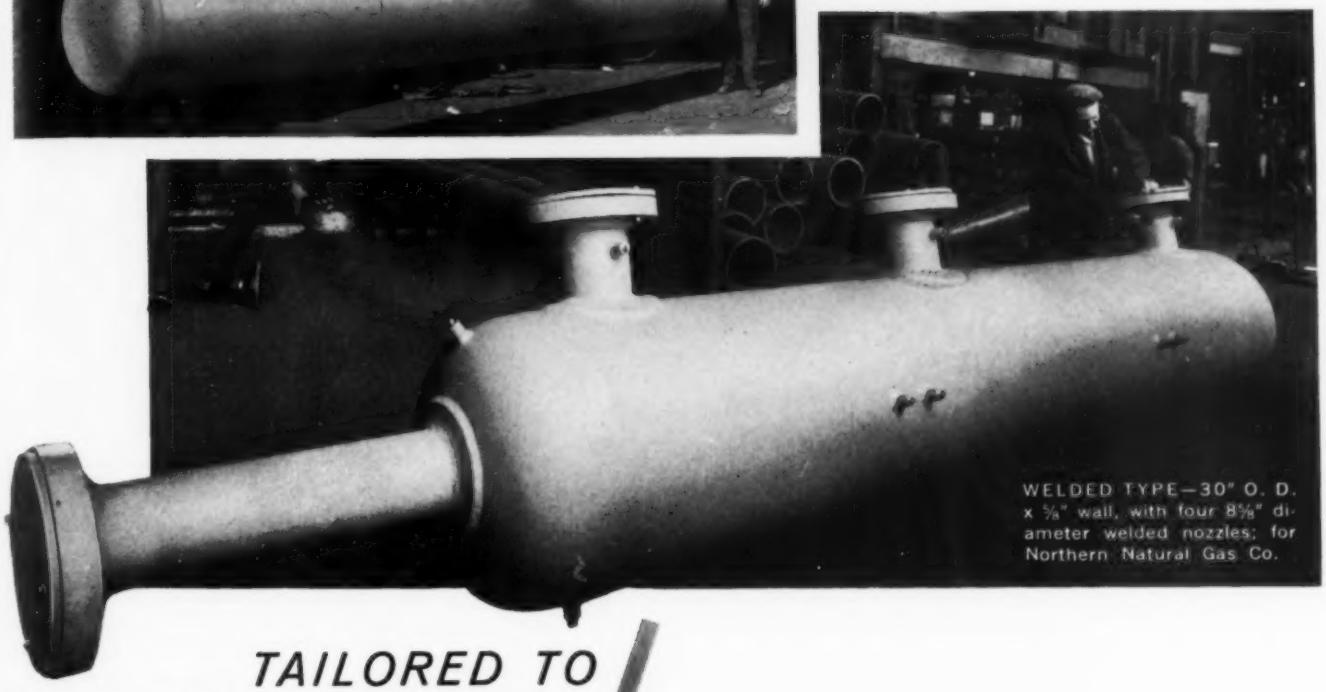
S. D. Day, 77, president of S. D. Day Company, died in a Houston hospital June 3.

Day had extensive service in the industry and founded the S. D. Day Company in 1949.

For more data on advertised products, use Readers' Service Cards, last page.



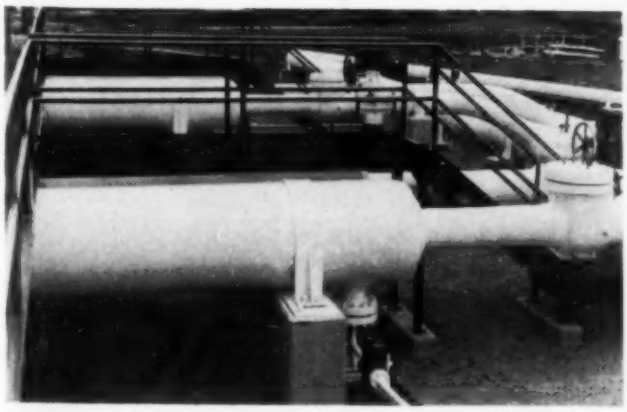
EXTRUDED TYPE—30" O. D. x 1¼" wall, with four 8" and one 12" diameter extruded nozzles; for Peoples Gulf Coast Natural Gas Pipeline Co.



WELDED TYPE—30" O. D. x ⅝" wall, with four 8⅝" diameter welded nozzles; for Northern Natural Gas Co.

TAILORED TO YOUR REQUIREMENTS

MIDWEST PULSATION DAMPENERS



Midwest—fabricated 34" pulsation dampener installed at Texas Gas Corporation's compressor station at Slaughters, Kentucky.

In any size or wall thickness, for operation at pressures up to 900 pounds or more, in Tri-Ten, A-212-B steel or any other weldable metal / Welded nozzle or extruded nozzle construction / Fabricated to code requirements / Excellent quality—long life / Dependable delivery—four fabrication plants across the nation. Send us details for quotation on your pulsation dampener requirements.

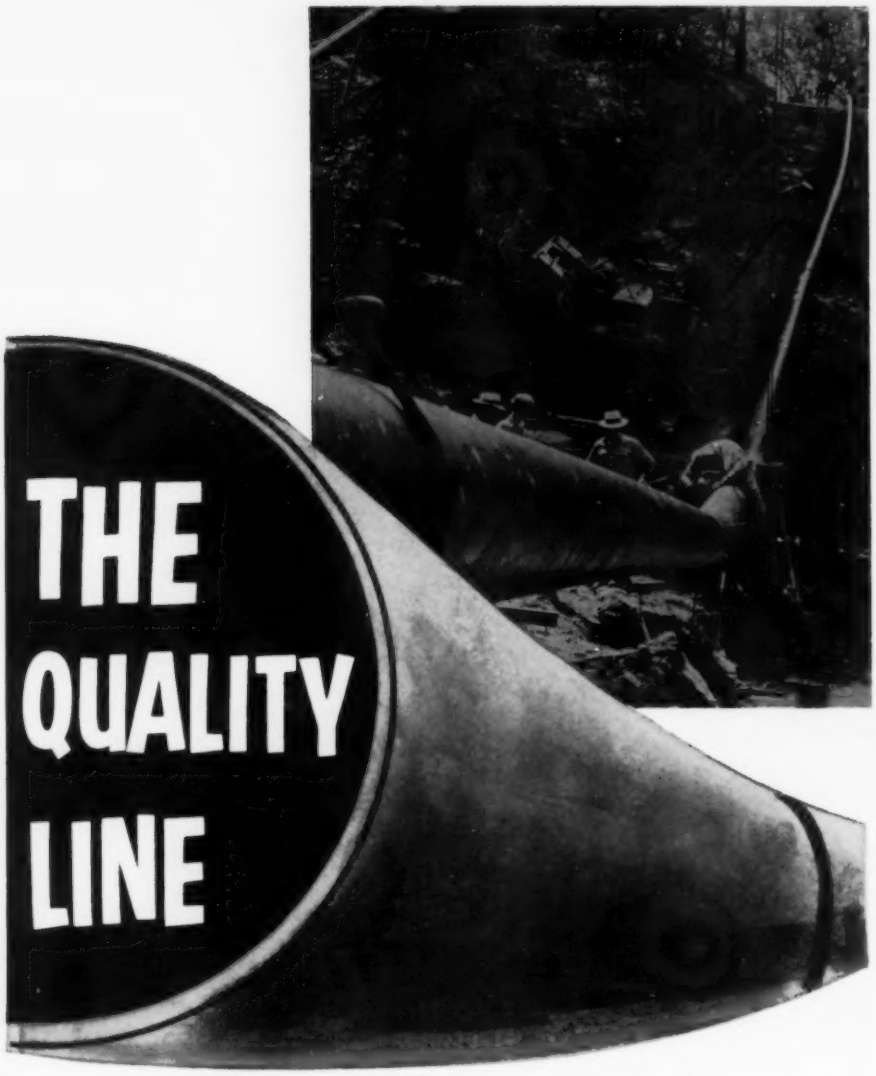
TODAY! Write for NEW bulletin 60-C describing Midwest Seamless and Welded-type fittings.

MIDWEST

6015

MIDWEST PIPING CO., INC.
1450 South Second Street • St. Louis 4, Mo.

For more data on advertised products, use Readers' Service Cards, last page.



LATEX QUALITY PIPELINES BRING REPEAT BUSINESS

For over a quarter of a century the Quality line has been synonymous with the name *LATEX*. *LATEX* is renowned for their ability to build quality line rapidly and efficiently.

REMEMBER, LATEX QUALITY BRINGS REPEAT BUSINESS "AGAIN AND AGAIN"

Another quality service of *LATEX* is CONSTRUCTION OF PEAK SHAVING PLANTS. Pictured here is Atlanta Gas Light Company's Riverdale peak shaving plant near Atlanta.

LATEX
SERVING 1/4 CENTURY

LATEX CONSTRUCTION CO.

P. O. BOX 12128 • ATLANTA 5, GEORGIA • CE 3-9414

WHO'S MEETING WHERE

July

ASCE, conference on civil engineering education, University of Michigan, Ann Arbor, Mich., July 6-8.

September

ASME, joint automatic control conference, Massachusetts Institute of Technology, Cambridge, Mass., September 7-9.

NGAA, Rocky Mountain Regional Meeting, Palliser Hotel, Calgary, Alb., September 15.

ASME-AIEE, power conference, Bellevue-Stratford Hotel, Philadelphia, Pa., September 15-16.

ASME, petroleum division meeting, Jung Hotel, New Orleans, Sept. 18-21.

Pacific Coast Gas Association, annual convention, Westward Ho Hotel, Phoenix, Ariz., September 21-23.

AIEE, electrical conference of petroleum industry, Hotel Skirvin, Oklahoma City, Sept. 25-28.

Instrument Society of America, 15th annual meeting, New York City, September 26-30.

Mid-West Gas Association, annual conference, Iowa State College, Ames Iowa, September 27-29.

October

NACE, 10th annual Western Region Conference, Sheraton-Palace Hotel, San Francisco, October 6-7.

NACE, Southeast Region Conference, Dinkler-Plaza Hotel, Atlanta, Ga., October 6-8.

AGA, annual convention, Atlantic City, N. J., October 10-12.

NACE, Northeast Region Conference, Prichard Hotel, Huntington, W. Va., Oct. 11-14.

ASME-ASLE, lubrication conference, Statler Hilton, Boston, October 17-19.

NACE, North Central Region Conference, Pfister Hotel, Milwaukee, October 19-20.

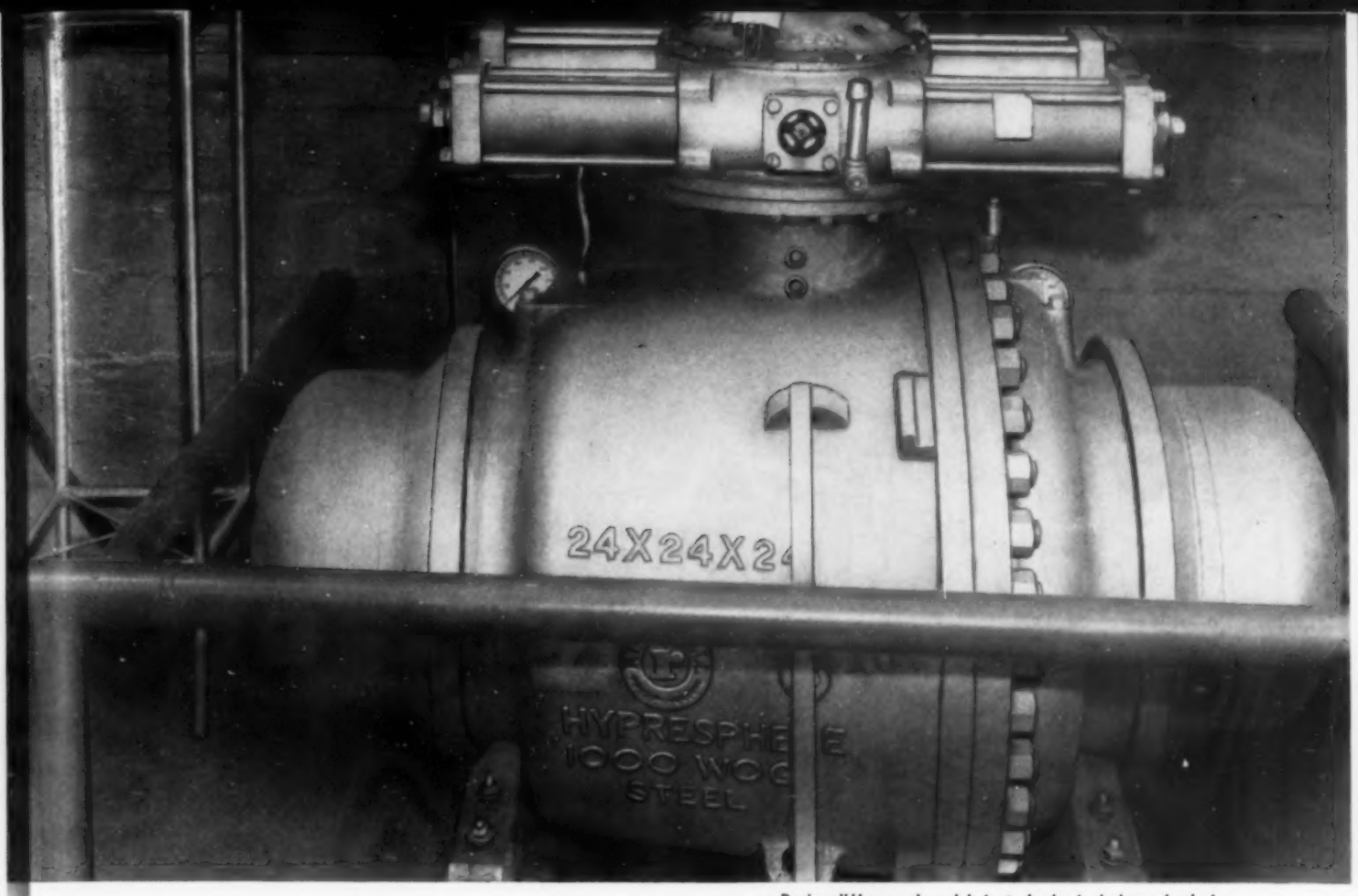
NACE, South Central Region Conference, Mayo Hotel, Tulsa, October 25-28.

NGAA, Southern Regional Meeting, Carlton Hotel, Tyler, Texas, October 28.

November

NACE, Canadian Region Eastern meeting, Sheraton Mount Royal Hotel, Montreal, Quebec, November 14-16.

NGAA, Panhandle Plains Regional meeting, Herring Hotel, Amarillo, Texas, November 18.



Rockwell Hypresphere lubricated spherical plug valve being tested through 10,000 full open-close operating cycles at 900 lb psi.

THE PIPELINE VALVE THAT WOULDN'T WEAR OUT

The Rockwell Hypresphere lubricated spherical plug valve shown above has been test operated from full open to full closed 10,000 times. Line pressure on the test fluid was built up to 900 psi for *each* full open-close test cycle. At test's end, there was no apparent wear and the valve held bottle tight shut-off!

In the Hypresphere (like all other Rockwell-Nordstrom *lubricated* plug valves), pressurized lubricant insures positive shut-off and prevents metal-to-metal wear. *To prove that this is fact and not theory, make your own inquiries on how many pipeline lubricated plug valves have ever had to be overhauled in the field or replaced.* Additional advantages of the Hypresphere: full round opening, exceptionally compact, and closure 2 to 5 times faster than non-lubricated valves. For complete details on the *complete* line of lubricated plug and spherical plug valves for pipeline services, write: Rockwell Manufacturing Company, Dept. 99-G, Pittsburgh 8, Pa. Canadian Valve Licensee: Peacock Brothers Limited or Rockwell International, S.A., Geneva, Switzerland.

Lubrication Makes the Difference

ROCKWELL HYPRESPHERE VALVES

another fine product by

ROCKWELL

This Rockwell Hypresphere valve, ready for buried installation, will save money at the outset by eliminating need for costly vaults.

SKINNER-SEAL
PIPE JOINT CLAMP STOPS LEAKS
at joint where pipe is screwed into fitting

SKINNER-SEAL
PIPE JOINT CLAMP stops leaks at joints where pipe is screwed into fitting. Any temperature—any pressure up to 2,000 pounds. Saves the cost of tearing out and renewing leaky fittings. Prevents shutdowns. In stock at most oil supply stores.

SKINNER-SEAL
EMERGENCY PIPE CLAMPS for safe, sure, lasting repair of splits and rust holes in pipe. No pressure too high. Anyone can apply in a few moments. Made in all sizes, ½" to 12," for steel and C.I. pipe. Stocked by practically all oil supply stores.

Complete line of Repair Clamps. Send for Catalog 54!

M. B. SKINNER CO.
SOUTH BEND 21, INDIANA

ASME, winter annual meeting, Statler Hilton, New York, November 27, December 2.

1961

January

Pipe Line Contractors Association, annual meeting, Fairmont and Mark Hopkins Hotels, San Francisco, January 15-18.

March

ASME, Gas Turbine Power Division, co-sponsored by the Department of Defense, sixth annual conference and exhibit, Shoreham Hotel, Washington, D. C., March 5-9.

NACE, seventeenth annual conference, Hotel Statler, Buffalo, N. Y., March 13-17.

April

PIEA-PESA, annual meeting, Galveston, Texas, April 11-13.

Southern Gas Association, annual convention, New Orleans, April 24-26.

May

AGA, Transmission Section, annual meeting, Brown Palace, Denver, May 25-26.

BOOKS

Measurement of Secondary Stresses in Pipelines, American Gas Association, 420 Lexington Ave., New York 17, $3.

The technical report summarizes results of a two-year study of the effects of secondary stresses on gas pipe lines. The pipe line research committee reviews stress-testing projects conducted throughout the country by 10 major gas transmission companies. These tests were planned and later analyzed by Battelle Memorial Institute researchers.

Principal objective of the program was to increase understanding of the magnitude of secondary stresses and their significance in the design and operation of transmission lines.

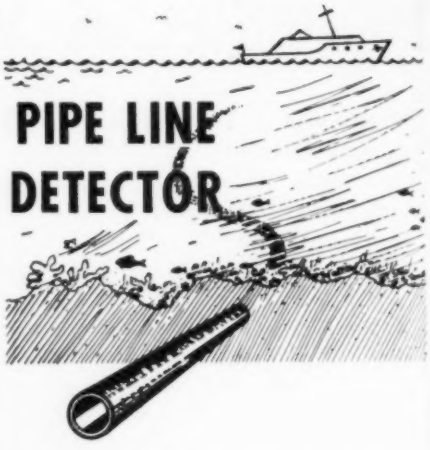
How to Build Profits by Controlling Costs, Dun & Bradstreet, Inc., P. O. Box 803, Church Street Station, New York 8, $1.

Written from the point of view of small business, Dun & Bradstreet's 48-page booklet deals with one of the most difficult problems facing businessmen—cost control.

First part of the booklet uses case history approach to common business problems experienced by a typical small business owner. It includes several suggestions for controlling costs. In the second part, there is a step-by-step examination of record keeping, analysis of figures and the use of ratios as a means of comparing performance.

The Small Business handbook includes a number of practical aids such as simple directions for computing operating and financial ratios, a five year chart for comparing performance and enabling a businessman to see rapidly the progress and direction of his business.

LESCHEN WIRE PORTER ROPE DIVISION
H. K. PORTER COMPANY, INC.



A MARINE PIPE LINE DETECTOR for river crossings, bays, marshes, and offshore—used to locate your pipe lines. This magnetic detector locates and determines the amount of overburden on your marine pipe—Locates them quickly, accurately, and economically.

MARINE GEOPHYSICAL SERVICES CORP.
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After 3 years of service, feather valves and other moving parts in air compressors show no trace of deposits or residue—still do not need cleaning.

"Cellulubes eliminate fires and explosions ...keep compressor parts clean"

says MR. T. E. DANIEL, Foreman, Cypress Compressor Station
Trunkline Gas Company, Cypress, Texas

"Since using Cellulube 220 in our air compressors we have never experienced or had any indication of fire or explosion in our compressed air systems," continues Mr. Daniel.

Installed at Trunkline's Cypress Compressor Station when it opened three years ago, Cellulubes thus provide an authoritative 7800-hour operating record that indicates not only efficient and far safer operation, but substantial savings as well. Mr. R. C. Carter, Trunkline's Compressor Department Superintendent, describes them thus:

"First and most important, of course, is the elimination of any risk to our personnel—from fire, explosion, or fragmentation. Secondly, we save on heavy equipment replacement costs, and thirdly, down-time losses.

"A major savings is in preventive maintenance. Formerly, we completely disassembled and cleaned air compressors every six months. Cellulubes keep machinery so clean that this interval has been indefinitely extended, and so far we've saved at least 60 man-hours. Finally, Cellulubes never get 'dirty,' nor do they burn away by friction or compression."

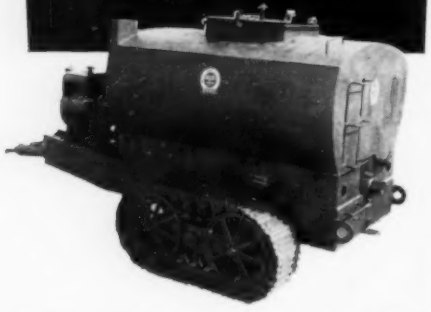
Cellulubes . . . the *safe* lubricants and hydraulic fluids . . . are available in six controlled viscosities. If you'd like a sample for evaluation, please let us know the application involved.
Celanese Chemical Company, a Division of Celanese Corporation of America, Dept. 576-G, 180 Madison Avenue, New York 16, N. Y.

Celanese® Cellulube®

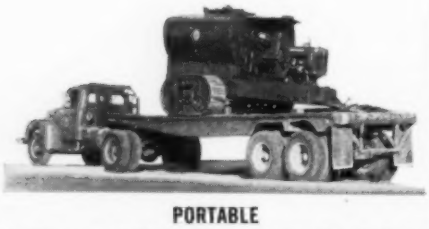
Cellulubes... Celanese CHEMICALS fire-resistant functional fluids

Canadian Affiliate: Canadian Chemical Co., Limited, Montreal, Toronto and Vancouver • Export Sales: Amcel Co., Inc., and Pan Amcel Co., Inc., 180 Madison Avenue, New York 16, N.Y.

DOPE
IS ALWAYS
HOT • READY and RIGHT from MYOCO ASPHALT KETTLES



Myoco asphalt kettles are designed to keep dope hot and always ready for instant use. Completely insulated, there is almost no temperature variation of filler between top and bottom. Coking, therefore, is unnecessary. Mechanically driven propeller and hydraulic bottom sweep prevent settling. Since the fuel tank is installed inside of frame, and protected from the firebox by the welded bulkhead, safety is assured. Available in 10, 27 and 30 barrel sizes, powered by a Wisconsin engine or its electric equivalent with Athey tracks, steel skids, or fitted for stationary use. Blower or mailbox burners are optional.



PORTABLE

The Myoco portable kettle is compactly designed to eliminate over-width permit for highway transportation.

WE RENT EVERYTHING FOR PIPELINE CONSTRUCTION

Write for our Complete Catalog

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PIPELINE EQUIPMENT AND SUPPLIES
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PArkview 3-0110
In Canada: MYOCO LIMITED, Rural Route 1, Midland Ave. N., Agincourt, Ontario, Canada
Tel. WA 2-9444

What's Happening among SERVICE and SUPPLY MEN

Pipeliners Visit Cal-Metal Pipe Mill

Watching steel move through forming rolls, representatives of oil and gas pipe line companies follow pipe manufacturing process at Cal-Metal Pipe Corporation of Louisiana's Baton Rouge mill. Cal-Metal manufactures high-yield, lightwall pipe in diameters from 6 through 42-inch. The plant has an annual capacity of approximately 200,000 tons of pipe.

United States Steel Names Assistant Vice Presidents

Two assistant vice presidents have been appointed by United States Steel Corporation's engineering department. P. S. Weaver was named assistant vice president—appropriations and Samuel Naismith becomes assistant vice president—facility planning.

Weaver started with the company in 1933 and Naismith joined United States Steel in 1936.

Briggs Filtration Announces Representative Appointment

Walter E. Yedlinsky has been named representative for industrial sales in western Pennsylvania for Briggs Filtration Company.

Before joining Briggs, Yedlinsky was a senior engineer concerned with the design of nuclear power plants for the U. S. Navy at Westinghouse Electric, Atomic Power Division.

Brown-Fogle Expands Facilities

Brown-Fogle Equipment Company is expanding its service facilities and plans adding automatic welding equipment to its line. President Charles Brown and vice president R. B. Fogle formed the company after purchasing the Benson Tractor Company and signed an agreement with Allis-Chalmers for distribution of its equipment in the Texas Gulf Coast area. Brown also is president of Southern Equipment and Tractor Co. in Louisiana. Pictured above, from left to right, are Fogle, Brown, John B. Woodburn, vice president, Southern Equipment, and Alvin Furlow, vice president Southern Equipment.

THE REPUTATION FOR GREATNESS IS MADE WITH ACHIEVEMENT!

SAM CARLINE HAS CREATED A "NETWORK OF ACHIEVEMENT" IN THE DEEP SOUTH . . . .

With Carline, achievement means growth. Sam Carline, Inc. has a network of achievement in the Deep South. Its 260 foot multimillion dollar offshore lay barge shown, is the latest expansion move. Capable of quartering 84 crewmen, the reconditioned Navy YF has recreation facilities, 2 - 35 ton stiffleg derricks and is capable of operating in 150 feet of water.

SAM CARLINE, Inc.

CALL 9031 • BERWICK, LOUISIANA

For more data on advertised products, use Readers' Service Cards, last page.

KOPPERS

on-the-spot availability of rings keeps your lines "on stream"

Dependable performance in all oil and gas applications

Koppers Piston Rings are now available in the field in a complete range of materials and a wide selection of types and sizes for every application in the oil and gas industry.

To gain trouble-free performance, lower operating costs and less frequent down-time, select Koppers Piston Rings—the choice of many original equipment manufacturers.

Koppers Piston Ring dependability, in even the most rugged applications, is backed with 38 years of experience in manufacturing rings of predictable performance.

If you have a ring problem, consult your Koppers field agent or write: KOPPERS COMPANY, INC., Piston and Sealing Ring Department, 7107 Scott Street, Baltimore 3, Maryland.

Send now for Koppers recommended Piston Ring Set-Ups applicable to the engines which you operate.

KOPPERS Sales Offices and Agents in these convenient locations:

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District Sales Office
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Supply Company
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El Paso, Texas

Nolan Sales Corp.
421 N. Cincinnati St.
Tulsa 20, Oklahoma

D. G. Silvey Co.
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Shreveport, Louisiana

Sample Bros.
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Sample Bros.
6315 Brookside Plaza
Kansas City 13, Missouri

KOPPERS

AMERICAN HAMMERED® INDUSTRIAL PISTON RINGS

Engineered Products Sold with *Service*

Corrosion Rectifying Co. Appoints F. G. Melkie Manager

Frank G. Melkie has been appointed head of the New Orleans division office of Corrosion Rectifying Co., Inc. Melkie's appointment is part of a diversification and expansion program of the corrosion protection services offered by Corrosion Rectifying.

Melkie

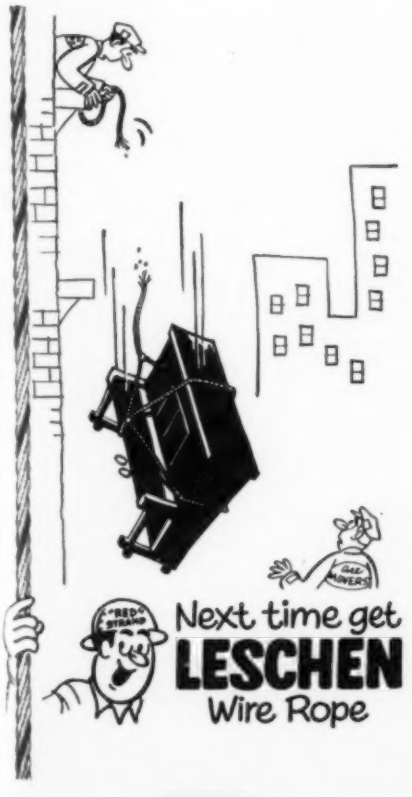
In addition to the design and installation of rectifier and cathodic protection systems, the company now offers services to design protection systems to correct all types of oil and gas corrosion problems under any condition.

Melkie formerly was area production manager for Tidewater Oil Co., specializing in corrosion problems.

Reliance Varnish Co. Merges With Coast Paint and Lacquer Company

Coast Paint and Lacquer Company has merged with Reliance Varnish Company and plans are being considered for expansion of Copons production facilities and personnel in Houston.

Kenneth W. McDowell, chairman of Coast Paint and Lacquer, will become president of the Coast Paint and Lacquer Division of Reliance. Carl Seefeld has been named vice president in charge of sales. McDowell also will be on the Reliance board of directors.



LESCHEN WIRE PORTER ROPE DIVISION
H. K. PORTER COMPANY, INC.

Where Temperatures and Pressures "GET HIGH"

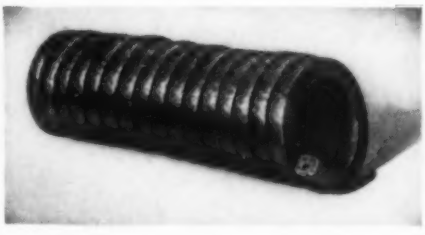
...you need these packings!

Style HP-2M – excels against severe temperatures and pressures. A braided asbestos packing reinforced with a monel wire insertion. For use on centrifugal and reciprocating pumps, valve stems, expansion joints, etc.

Style No. 30 – a very dense braided asbestos packing, highly resistant to high pressures. For use against petroleum products at high temperatures and pressures.

Style HP-RC – a wrapped asbestos cloth packing with a resilient rubber core. For use on steam hammers, expansion joints, pumps and piston rods calling for high pressure steam, air and gases at temperatures to 600 degrees F.

Style HP-RB –for high pressure steam service up to 600 degrees F. Constructed with a core of accordion-folded asbestos cloth and a resilient rubber back, around which is wrapped a closely woven asbestos cloth jacket.



Aquapak Hydraulic Packing – a semi-metallic packing designed to withstand severe hydraulic pressures. Will give satisfactory service on pressures as high as 10,000 pounds. For use against hot and cold water on centrifugal and reciprocating pumps, outside packed boiler feed pumps and similar equipment.

ALLPAX
"The Packing that Packs All"

SEND FOR OUR NEW CATALOG — TODAY!

A complete line of packing, tools, gasket materials. Ask for dealer information and price schedules.

THE ALLPAX COMPANY, INC.
160 Jefferson Ave., Mamaroneck, N. Y.
CANADIAN DISTRIBUTORS: Albion Asbestos Packings Ltd., Montreal 8, Quebec

Dresser Industries, Inc., Announces New Vice President

J. D. Mayson has been named vice president and secretary and John V. James has been appointed controller of Dresser Industries, Inc. Mayson formerly was secretary and James had been vice president-finance of Clark Bros. Co.

Mayson joined Dresser in 1944, and was named director, Legal Department in 1949. In 1957, he became assistant secretary and was promoted to secretary in 1959. James joined the company in 1957, and served as assistant controller of Dresser Industries, Inc., before being named vice president of Clark Bros. in 1958.

Standard Pipeprotection Names G. W. Prager Sales Representative

Standard Pipeprotection Inc., has named G. W. Prager sales representative in the territories of Colorado, Wyoming, Montana, Utah and Idaho. Prager formerly was associated with the E. W. Robinson Supply Company.

Charles M. Beeghly Elected Jones & Laughlin Steel President

Charles M. Beeghly has been elected president of Jones & Laughlin Steel Corporation. He had been executive vice president since 1958, and a director since 1957. Avery C. Adams, who had served as chairman and president, will continue as chairman.

A veteran of more than 25 years in the steel industry, Beeghly was president of the J&L Strip Steel Division prior to his appointment as executive vice president of the Corporation. He started his career in 1934, and has worked in sales, production and finance.

Loftin

Weston, Jr.

F. H. Maloney Co. Appoints New Directors and Officers

F. H. Maloney Co. has named two new directors and announced two appointments in management positions. B. Hunter Loftin and Ray F. Weston, Jr., become members of the board. Weston was named secretary-treasurer and William B. Campbell was promoted to vice-president—technical services.

Campbell

Loftin is a partner in the law firm of Butler, Binion, Rice and Cook. He has been general counsel for Maloney the past nine years. He specializes in corporate and tax matters. Weston has been associated with the Maloney Company for the past five years and was office manager before his recent appointment.

Campbell joined the company three years ago as advertising manager and his duties were expanded to include the direction of special services related to development and marketing of new products.

Clark Bros. Co. Appoints District, Branch Managers

Clark Bros. Co. has named William A. Roever manager of its newly created Dallas district office and James H. Bews has been appointed San Francisco branch manager.

Roever has been with Clark since 1946, serving as sales engineer, Dallas branch manager and since 1959, senior branch manager. The new Dallas office is located at 4512 North Central Expressway, Dallas 6. Bews joined Clark in 1951, and has been technical service engineer, application engineer, and sales engineer at Los Angeles since 1957.

H. K. Porter Co. Acquires Allied Paint Mfg. Co. of Tulsa

H. K. Porter Co. has acquired Allied Paint Mfg. Co. of Tulsa and will make it the Tulsa works of Porter's paint division.

Ainslie Perrault, previously president of Allied Paint, will serve as the Tulsa works manager. Porter plans to increase capacity at the plant.

BUT Oil Gaging Needs Precision Equipment from W. H. Curtin & Co.

Complete stocks of Petroleum Gaging Equipment meeting all API and ASTM specifications are maintained for immediate delivery by W. H. Curtin & Co. Curtin oil testing centrifuges and tubes, thermometers and hydrometers, as well as all other gaging equipment, are of the finest quality and constructed for a long lifetime of use in field or laboratory. Replacement parts are readily available for all equipment. On your next order, specify the high quality gaging equipment you can rely on from W. H. Curtin & Co.

Write or call for your FREE copy of Curtin's 24-page illustrated catalog G-56 *Petroleum Gaging Equipment.*

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Established 1922 U.S.A.

OUR VITAL PIPELINES

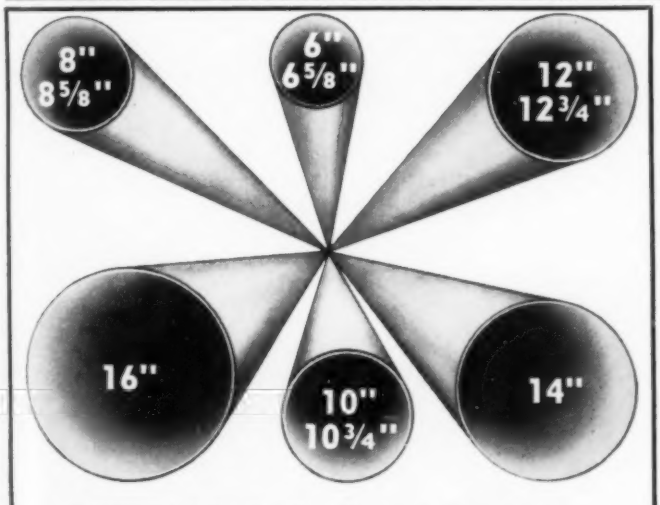
THE COMMON CAROTID ARTERIES . The two principal arteries of the head. Beginning at the neck, they split into subclavian arteries, thence into countless small branches to nourish the needs of the brain.

By supplying energy and raw materials for our economic and industrial centers, the pipelines of our country are much like the arteries of the body—as vital as life itself.

From the field direct to the consumer—vital pipelines are built better Majestically.

from the field direct to the consumer

majestic
CONTRACTORS, INC.
HEAD OFFICE: 1902 TENNESSEE BUILDING, HOUSTON, TEXAS



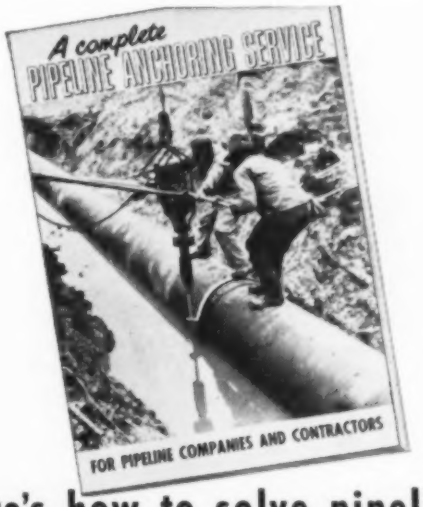
NEW high frequency, resistance welded pipe

If you want a closer source for pipe that meets the highest standards of the industry, better talk to Valley. New resistance welding and process control facilities assure you of the quality you demand. Ideal as line pipe for petroleum, gas, water, etc. Surface casing also available. Special wrappings and coatings.

Sizes: 6" 6⅝" 8" 8⅝" 10" 10¾" 12" 12¾" 14" 16" in wall thicknesses to .219.

Write or call Steel Pipe Division

VALLEY MANUFACTURING COMPANY
VALLEY, NEBRASKA



Here's how to solve pipeline floatation problems . . .

Use the Chance Field Service Plan . . . the surest, easiest, most reliable, and least expensive way to anchor pipelines. You'll cut costs about 85% by using Chance Screw Anchors and tie-down brackets. And, you can have the whole project engineered, installed, and tested by qualified technicians at far less cost than counter weighting.

By making soil test probes, Chance engineers can tell you where anchors should be used, the sizes needed, and the proper depth. To learn how you can get the whole anchoring job done quickly, easily, inexpensively—send or call for this booklet.

Petroleum Equipment Engineering And Services Division Of

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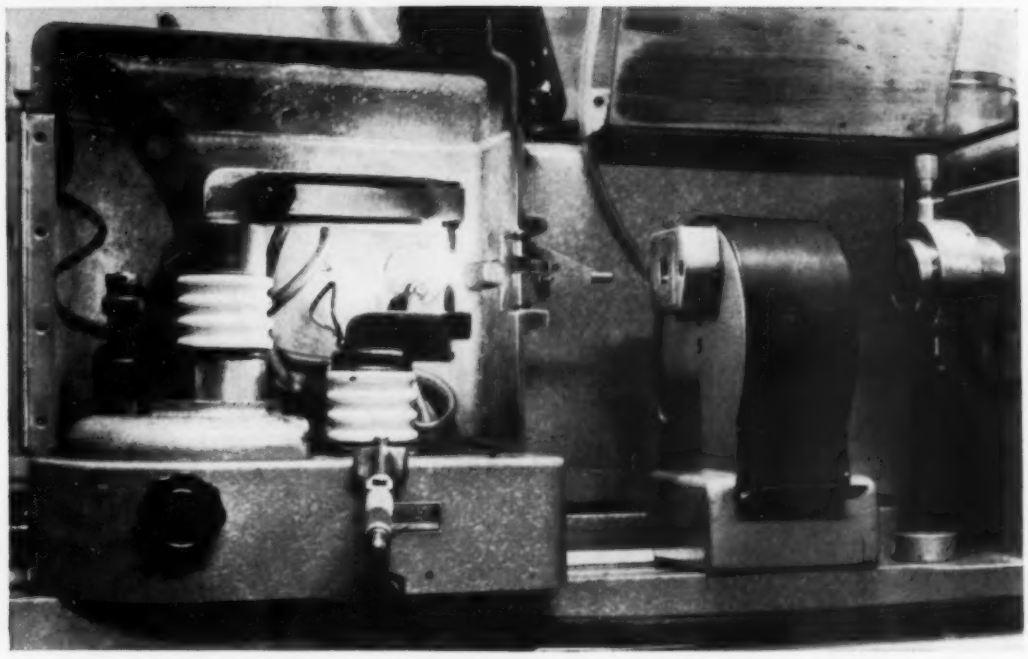
INTERNATIONAL DIVISION • CENTRALIA, MO., U. S. A.

10,125 tests a day assure consistent quality in

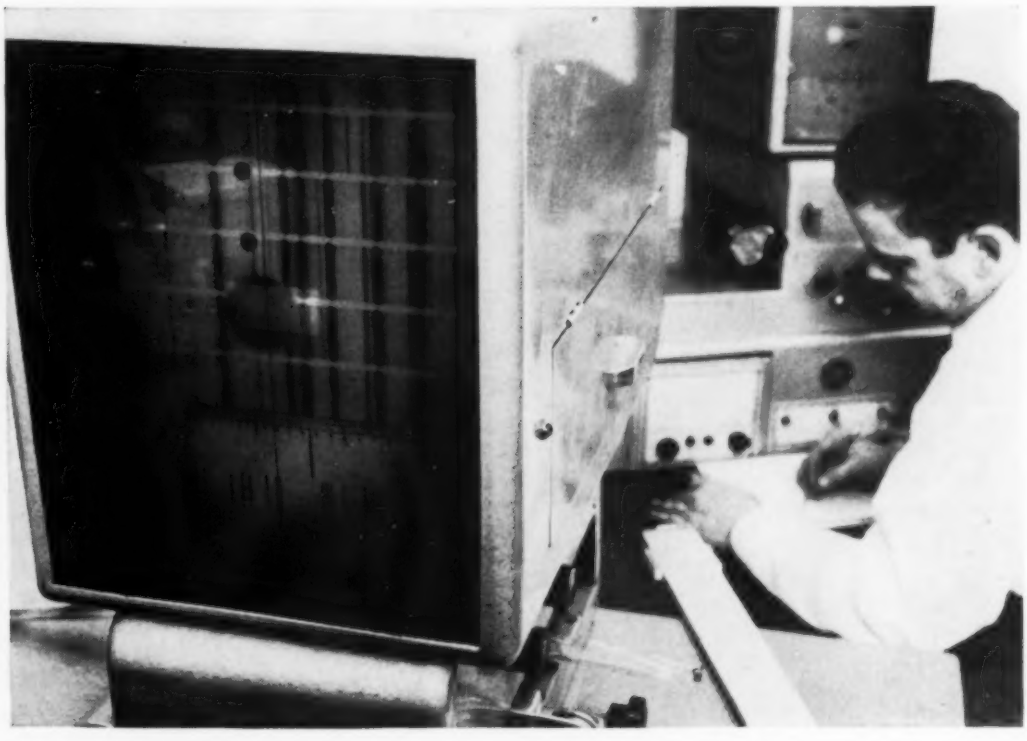
GULF MAKES THINGS

These bottles contain samples of a variety of Gulf fuels and lubricants. Each has been subjected to a series of quality control tests at Gulf laboratories. Any one of the tags shown might carry the "pedigree" of a Gulf product for a drilling rig or a pipeline pumping station.

Product purity is policed constantly at Gulf. During the refining process, samples from *every* lot of Gulf gasoline, diesel fuel, lubricating oil and grease are tested and re-tested to make sure that formulations are exact and that impurities are essentially eliminated. For ex-



Emission Spectrograph (above) causes undesirable elements in a petroleum sample to emit their characteristic light spectrum which is photographed on a strip of film. In the Densitometer (below) the spectrum on the film is evaluated to identify the presence of metal contaminants down to less than one part per million.



every Gulf® product . . .

RUN BETTER!

ample, Gulfcrest® 44, world's leading turbine oil, is quality-controlled to limit contamination to less than one part per million.

A continuing program of quality control tests is one of the reasons we say: Gulf Makes Things Run Better!

GULF OIL CORPORATION
Department DM, Gulf Building
Pittsburgh 30, Pennsylvania

GULF®

For more data on advertised products, use Readers' Service Cards, last page.

What's New in EQUIPMENT

To receive more information on all new equipment articles use Readers' Service Card, last page of this issue.

Crawler Type Shovel Crane

An all new tractor type crawler has been developed by Link-Belt Speeder Corporation for its ¾ yard LS-78 shovel-crane. Designed for long distance traveling and greater traction, the crane has departed in design from conventional shovel-crane lower.

Some of the key differences are the tractor type track belt with full grouser shoes; a compensating arrangement to automatically relieve excessive track tension caused by wedged obstacles; simple built-in track adjustment actuated by a grease gun and extra high ground clearance with clean, flat underbody.

Except for special adaptations, the upper machinery has the same basic design as all "78" series models. Adaptations include two-speed travel in either direction and higher oil level in the deck gear compartment, plus a deeper oil pan under the engine.

For more data, circle **No. E1** on Readers' Service Card, last page this issue.

Road Boring Machine

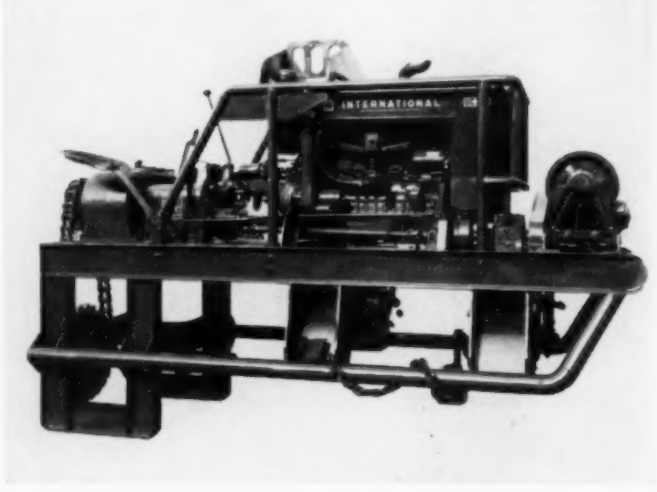
Available in 30 and 42-inch models, Crutcher-Rolfs-Cummings, Inc., has announced its new boring machine for highway, railroad, and other pipe line crossings.

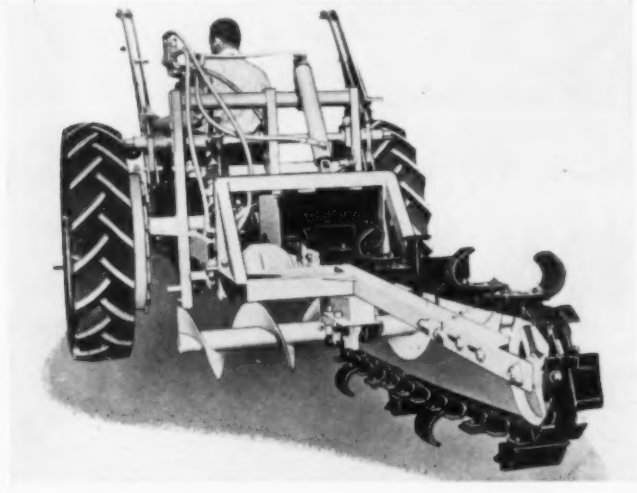
Adjustable chains with chain clamps are utilized as pullhooks. There are no pusher-lugs to be welded on or to be burned off. Other features include an easy-to-use heavy duty ratchet casing chain, heavy duty speed reduction unit for extreme ruggedness, a smooth, shock-free drive through use of a special torque converter, and winch controls that handle six forward speed variations.

All working parts are easy to reach for inspection and maintenance.

(This item supplements Crutcher-Rolfs-Cummings, Inc. data on pages 139-142 of the Pipe Line Catalog, Second Revision.)

For more data, circle **No. E2** on Readers' Service Card, last page this issue.





Tractor-Mounted Ditcher

Designed specifically to fit all three-point tractor hitches, the Vermeer Manufacturing Company 3P Pow-R-Ditcher is capable of digging a wide variety of trenches.

The new model is quickly attached or detached, has a digging width of 6 inches to 16 inches and will cut to a depth of 4½ feet. Digging chain is same as used on larger Vermeer ditchers. Tractor mounted ditcher has new hydraulic actuated travel ratchet device that gives full control of digging speed from one control lever.

The PTO shaft is equipped with a double disc friction slip clutch for digging safety.

For more data, circle **No. E3** on Readers' Service Card, last page this issue.

PUSH BUTTON PIPELINE

CHEROKEE PIPE LINE CO.

Write Rex Grey for your personal copy of . . .

"Control . . . the answer to increased pipe line profits"

SIE, through solid state electronics brings you the latest developments in remote supervision, computing and control.

- **Automatic Sequencing and Load Control**
- **Data Logging**
- **Alarm Scanning and Mimic Display**
- **Deviation and rate-of-change printout and alarm**

Designed for long life and reliability with highest data density and scan rate of any system . . . by

Control System Specialists devoted to the oil industry

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SOUTHWESTERN INDUSTRIAL ELECTRONICS CO.

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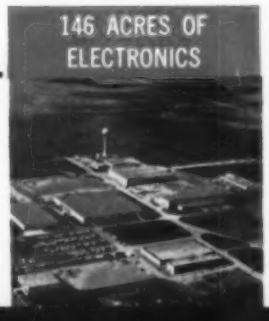
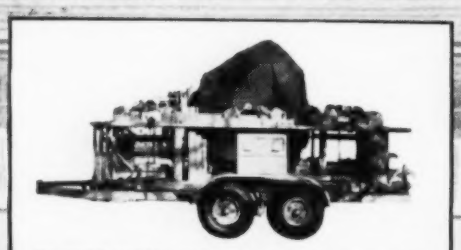


NOW! A portable high-speed taping machine for Polyken cleans, tapes and



In road-ready position, unit is compact and completely mobile. Comes on 4-wheel tandem trailer or on steel skids. With 80 feet of pipe-handling trackage.

New Polyken tape method handles ¾" to 4" pipe, cleans and coats 2,500 feet per hour and sets up anywhere

Probably the best thing about the Betzel taping machine and Polyken tape is the absence of all the nasty problems of hot dope. The highly mobile "Betzie," developed jointly by Polyken and A. E. Betzel, sets up in an hour (comes down in half the time).

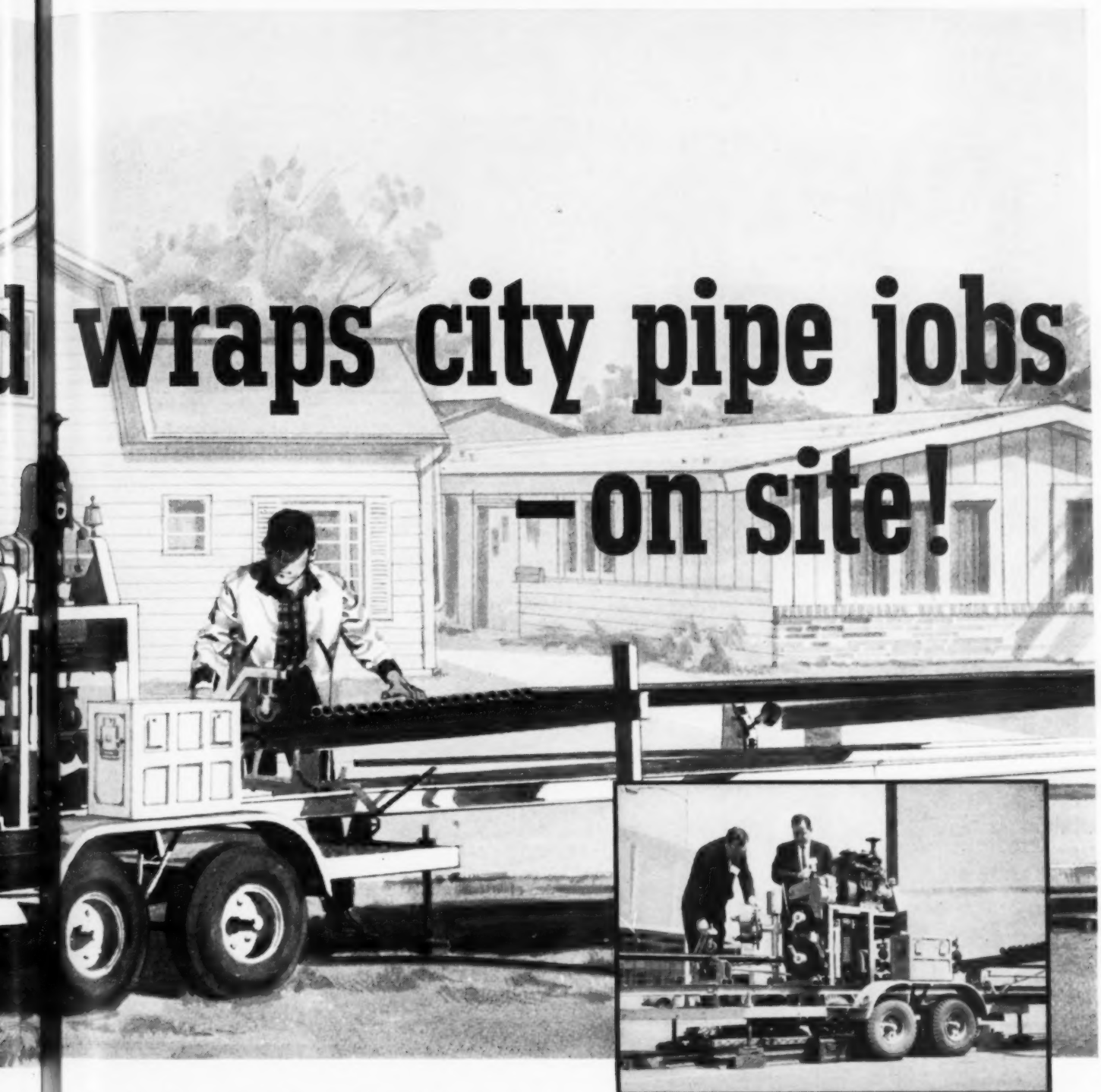
With only 6 men, or less, you run a continuous cleaning, coating and wrapping operation that processes 2,500 lineal feet per hour. Takes only 10 minutes to switch pipe sizes. And the savings? Well, just compare the time, labor, and small investment against the average hot dope operation.

The practical Polyken way

With Polyken tape you know the coating is always ready. Goes on factory-smooth, too. No primer, no drying or cooling time. No fumes or fire hazards.

What's more, permanent Polyken tape can take almost anything—as already proved by its many hundreds of miles and years of hard work. It's being used in such tough terrain as the

d wraps city pipe jobs —on site!



Iranian desert, Canadian cold, Florida swamps and southern California mountains.

For the full particulars on both machine and tape, look up your Polyken representative. Or simply send the coupon below.

As the pipe spins through the "Betzie," twin powered brush heads afford dynamic cleaning—as shown in this demonstration at the 1960 N.A.C.E. meeting in Dallas, Texas. Other standard equipment includes twin brake-type tape and outer wrap spindles for rapid change of rolls, and an adhesive attachment for fast-gluing outerwrap.

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Polyken Sales Division

Polyken Sales Division, Dept. PI-7
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Gentlemen: Please provide me with information on the new Polyken pre-coating method using the Betzel tapester.

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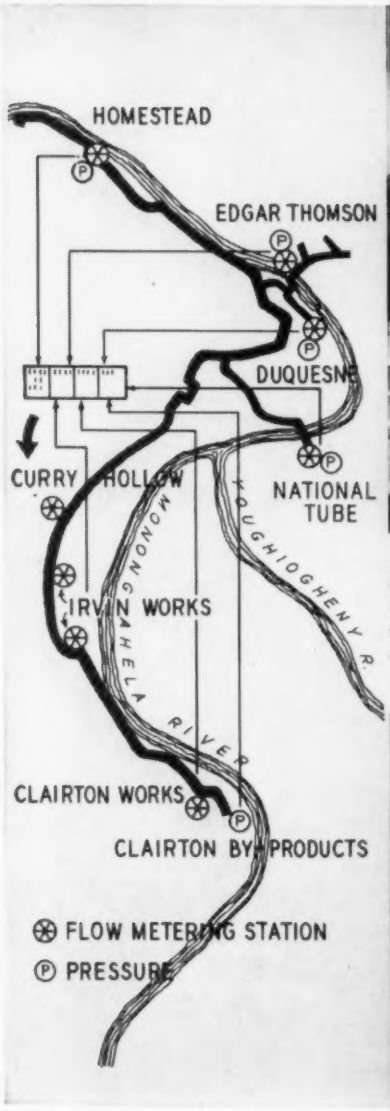
For more data on advertised products, use Readers' Service Cards, last page.



▲ **NINE METER RUNS** for coke-oven gas (left) and three for natural gas (right) at Carnegie's Curry Hollow Station give telemetering system part of its information. Coke-oven gas arrives at Curry Hollow in 55" mains, said to be largest in world.

BRISTOL METAMETER* telemetering instruments (panels at right and rear), in Curry Hollow Station of Carnegie Natural Gas Company, give dispatcher the continuous, up-to-the-second information he needs to control gas flow to six U.S. Steel plants along the Monongahela River. (See map.) ▼

GAS FOR THE MILLS OF U.S. STEEL

...telemetered by Bristol

Supplying the U. S. Steel plants along the Monongahela River with sufficient fuel to carry on operations is the primary mission of Carnegie Natural Gas Company, Pittsburgh, Pa., a subsidiary of the United States Steel Corporation.

Bristol Metameter* Telemetering gives the gas dispatcher, at the Curry Hollow Station, all the information he needs for efficient, economical pipeline operation.

At Curry Hollow (see map), Carnegie mixes natural gas from company-owned fields to supplement artificial gas produced at the Clairton By-Product Coke Works. Some of the coke-oven gas is used at the Clairton and Irvin Steel works. The mixed gas is supplied to the remaining plants.

The Bristol telemetering system measures individual gas flows and pressures in every main. Individual flows are totalized at Homestead, Irvin, Duquesne, and Edgar Thomson Works and transmitted to the dispatcher's office in Curry Hollow. At Curry Hollow, the Irvin and Clairton Steel Works flows are again totalized with the flow in the 55-inch mains from Clairton to secure the total coke-oven gas output.

Why not find out how Bristol telemetering can improve *your* plant or operations? Bristol Metameter systems are in service by the thousands, today, on natural gas pipelines, oil pipelines, gas distribution systems, electrical transmission networks, steel plants, water distribution systems and in industrial plants. Highly-trained Bristol engineers, drawing upon Bristol's more than 45 years' experience in industrial telemetering, are available to work with you in planning, design, and installation.

For details, write for bulletin M1710. The Bristol Company, 114 Bristol Road, Waterbury 20, Conn. *T.M. Reg. U.S. Pat. Off.

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BRISTOL... for improved production through measurement and control

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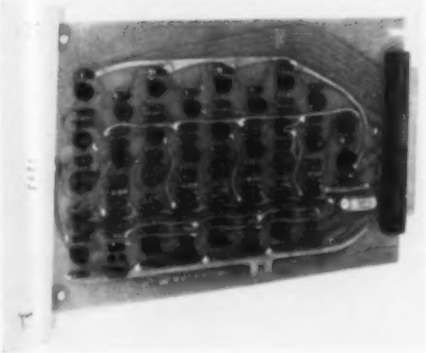


Solid-State Modules

Solid-state modules for use in acquisition and processing of test data at high speeds has been introduced by Minneapolis-Honeywell Regulator Company.

Digital systems can be assembled to multiplex and digitize data at rates up to 15,000 samples per second within an accuracy of 0.05 percent, according to the manufacturer. Each module makes use of standard logic circuitry and performs a specific function. The company will develop complete systems or make individual modules available as standard units for those building their own systems.

For more data, circle **No. E4** on Readers' Service Card, last page this issue.

Gravitometer

The newly developed Sinclair-Cenco Gravitometer can be used to blend crude oil products or a variety of other liquids to a constant outgoing gravity. It is especially designed to direct liquids of differing gravity into specific pipe lines or storage facilities, to continuously measure gravity of a liquid flowing through a pipe line for the purpose of quality control and to obtain a permanent gravity record. It records gravity corrected to 60 degrees regardless of the flowing liquid temperature.

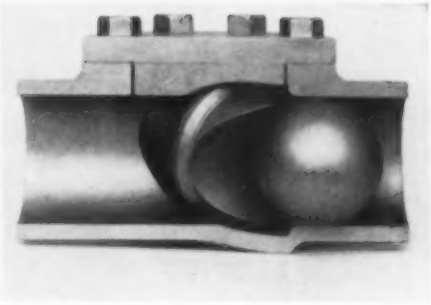
Central Scientific Company has been licensed to manufacture and sell the instrument. Several measuring ranges are available. Supplied with a detailed instruction manual, unit sells for $3,750.

For more data, circle **No. E5** on Readers' Service Card, last page this issue.

Plastic Anode Support

Manufactured with fiberglass and polyester resin to support up to 1,800 pounds of direct pull, a plastic anode support has been introduced by Tejas Plastics Material Supply Co. The support hangs vertically in water and oil storage tanks and is designed for workman operating from the top of tanks when installing and replacing anodes in cathodic protection.

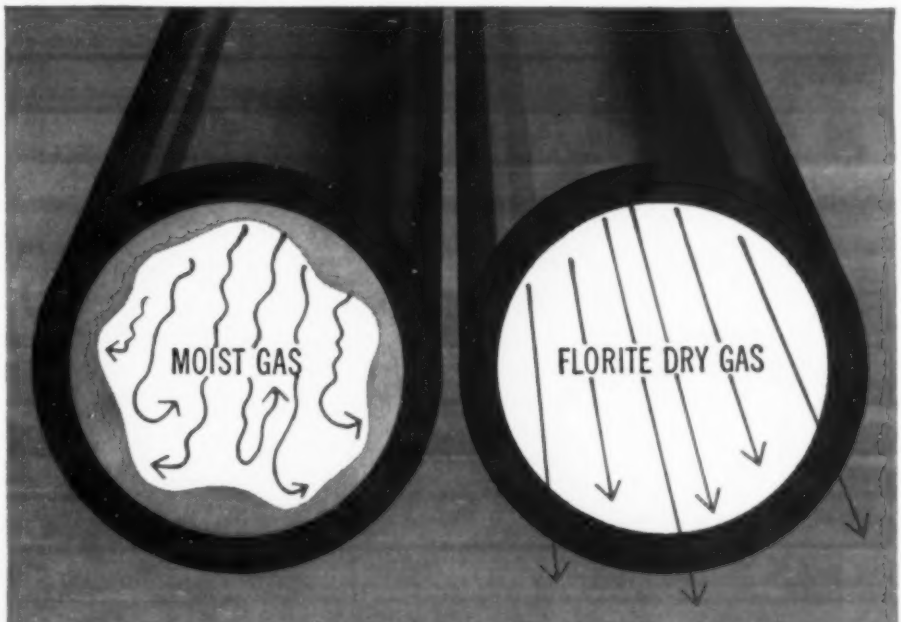
For more data, circle **No. E6** on Readers' Service Card, last page this issue.



Check Valve

For specific use on lines where ball-marking of interface or batch change is employed and for easy passage of all conventional scrapers, a new check valve with side hinged clapper has been developed.

Manufactured by Frank Wheatley Pump & Valve Mfr., the sphere-clear valve features the swinging door principle. In the valve, the ball enters the valve and contacts a conduit-shaped clapper. Clapper



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Dry Your Gas With FLORITE®

During cold spells, gas and water vapor tend to form ice-like hydrates on the inside walls of pipeline and instrumentation equipment. These deposits cause turbulent gas flow which leads to pressure drop and the headaches, lost time and money it entails.

Dehydration of your gas with granular FLORITE Desiccant lowers its water content well below normal pipeline specifications. Hydrate deposits cannot form.

FLORITE can absorb 20% of its weight in water and is easily regenerated in place by heating to 350°F. It won't swell or disintegrate in water and FLORITE offers no source of contamination or corrosion.

More information about quality FLORITE Desiccant and how it can save you from such troubles as rusting, freezing and fogging will be gladly furnished upon request.

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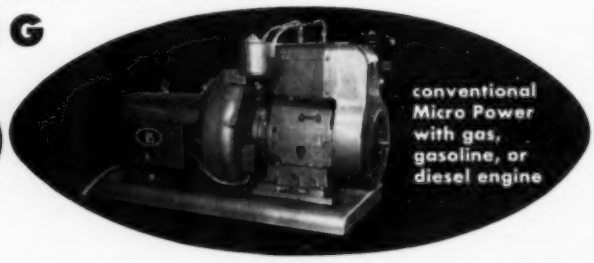


MICRO POWER

Heart of the microwave communications link between the Williams and the Seligman, Arizona, compressor station of El Paso Natural Gas Company is a United States Motors Corporation Micro Power. The engine of the conventional Micro Power in this case is replaced by a DC motor which is fed from the station batteries, from which all supervisory and telemetering equipment operates. Should the AC commercial power fail, the Micro Power continues to supply the microwave without voltage drop, droop, or break. Micro Power operates from, but isolates the microwave from the commercial power and removes the bad effects of voltage dips and peaks.

MICRO POWER operates with the main source of power. There are no transfer switches, no starting batteries with Micro Power. Available in 1500, 3000, 5000 and 10,000 watt capacities; for gas, gasoline or diesel engine emergency drive. For complete information, write . . .

UNITED STATES MOTORS CORPORATION

112 West Fifth Avenue • OSHKOSH, WISCONSIN

floats on thrust bearings and is controlled by a one-piece hinge pin. Swinging to the side and recessing completely into the body of the valve, the clapper is hinged on an 8 degree angle. The valves are available in sizes 1 through 36 inches in steel, semi-steel, or aluminum bronze for all API, ASA fittings.

For more data, circle **No. E7** on Readers' Service Card, last page this issue.

Cathodic Protection Check

An aerial survey indicator which enables aircraft to monitor the condition of cathodic protection stations in remote or isolated areas has been introduced by the Pipetron Company. The indicator consists of two separate parts; a control box which performed monitoring or sensing function and the indicator which gives the visual evidence. Indicator is mounted on the pole above the station which houses the control box.

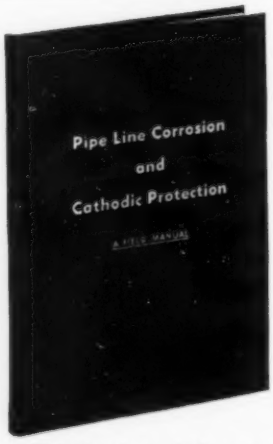
The indicators flag rotates under normal condition and is motionless under "failed" conditions. Indicator also can be used to monitor other equipment in inaccessible or remote locations.

For more data, circle **No. E8** on Readers' Service Card, last page this issue.

Engine Lube Oil

A new heavy-duty lube oil for use in over-the-road trucks and in stationary industrial engines has been developed by Micro-Lube. The lubricant contains a high concentration of Cyclohexanone, which suspends carbon formed in normal engine combustion and prevents formation of harmful deposits. It also eliminates engine moisture.

For more data, circle **No. E9** on Readers' Service Card, last page this issue.



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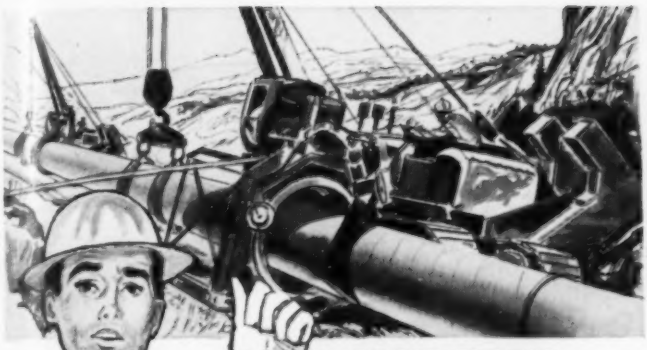


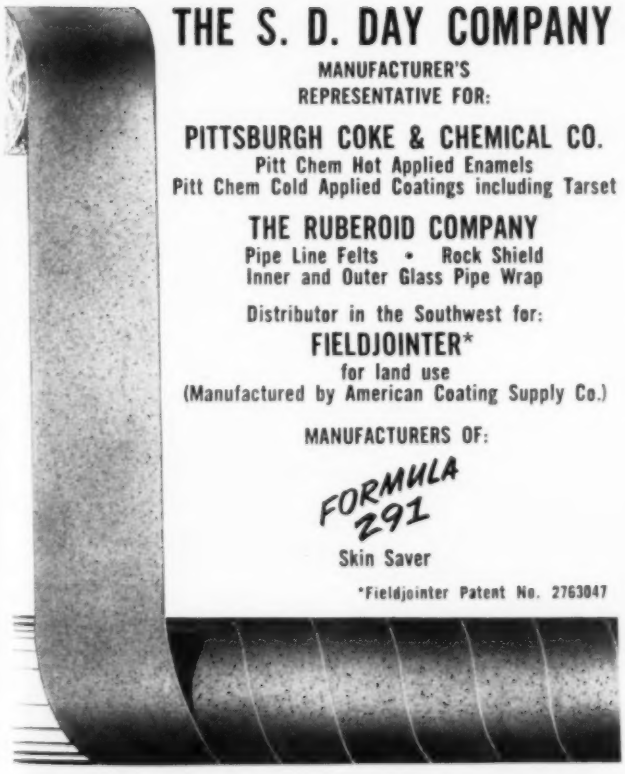
NEW CORR-PREV TAPE COATING TEAM CUTS PIPE WRAPPING TIME

CHASEKOTE* Polyethylene Tape Coating
CHASEWRAP* Abrasion-Resistant Overwrap

At last! Here's a *one-source* tape coating package that offers all the items needed — including high-speed wrapping machinery — to save time, and save you money! This new CORR-PREV Team also gives you all the corrosion-fighting advantages of time-proved, job-proved *polyethylene* tape. No hot dope mess, drying time or clean-up problems. Half the spread. The result: More footage per day at *lowest applied cost* . . . plus longer lasting pipe protection, with far less cathodic current demand. Want samples, specs, prices? Write **CHASE & SONS, INC., 26 SPRUCE ST., NORTH QUINCY, MASS.**

CORR-PREV DIVISION

*Trade name of Chase & Sons, Inc., long-famous for protective and insulating tapes for electrical wire and cable.



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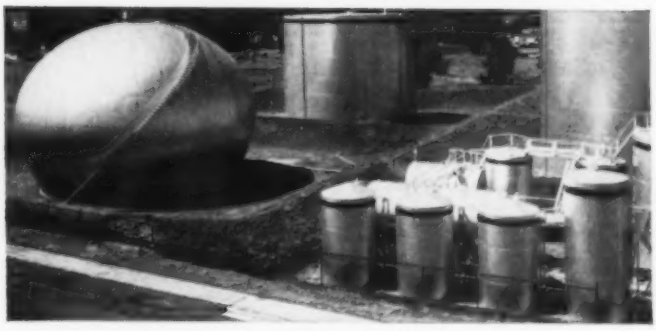
STOP WEEDS YEAR 'ROUND with UROX® Weed Killer



Just one application controls weeds and brush for 8 to 18 months!

Don't take chances! Wherever weeds and brush are a fire hazard—on tank farms, along pipelines, around refineries and pumping stations—wipe them out faster, easier and at lower cost with amazingly effective UROX Weed Killer.

Longer lasting! Economical! One application gives you 8 to 18 months control. And effects are cumulative. Light "booster" doses extend control from year to year.

Available in 2 easy-to-use forms! *Liquid* UROX Weed Killer is ideal for spraying large overgrown areas. Won't clog spray nozzles or strainers. Does not precipitate out in the tank. Stays in solution perfectly. *Granular* UROX is the convenient, inexpensive way to treat small weed-infested areas. Can be applied quickly and easily with any mechanical or hand-operated spreader.

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Weed Killer Dept. PI-70
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For more data on advertised products, use Readers' Service Cards, last page.

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Supervisory Control

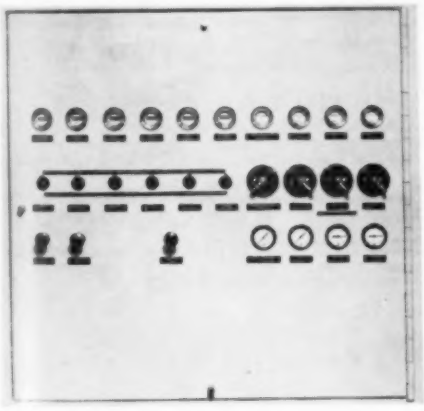
Supervisory control for remote indicating, telemetering and control of any apparatus, such as pump stations, which has provision for local control has been developed by General Electric Company.

Transistorized logic elements, "thinking components" of the equipment, direct and receive operation messages to and from remote apparatus through a master station-remote station system. These elements are plug-in cards utilizing transistors and diodes. There are no moving parts in the solid states supervisory equipment.

Computers were used in the design to give logic elements optimum in-the-field performance. System is designed to operate on any two-way communication channel including low-cost telegraph-grade leased wire.

(This item supplements General Electric Company data on pages 199-202 of the Pipe Line Catalog, Second Revision.)

For more data, circle **No. E10** on Readers' Service Card, last page this issue.

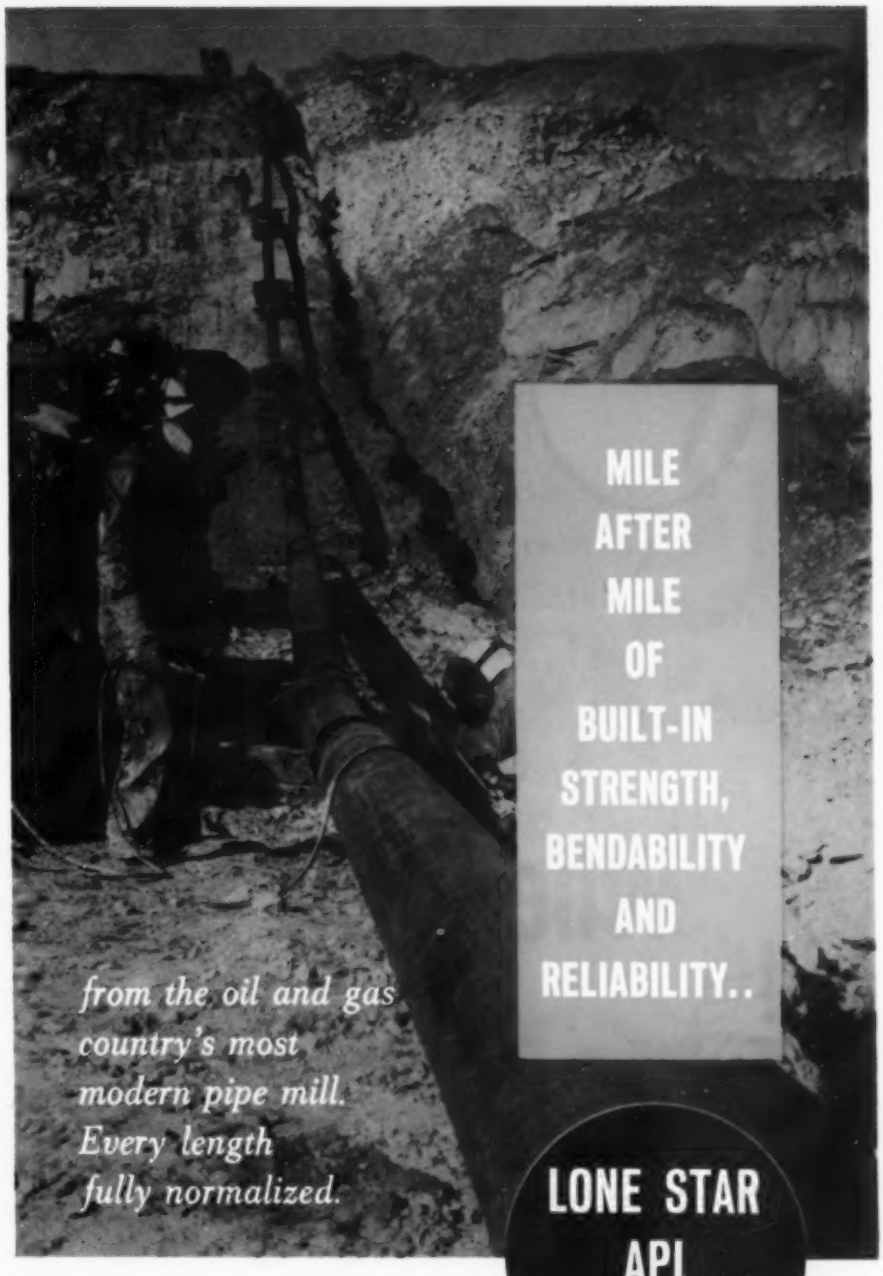


Pneumatic Engine Controls

Pneumatic engine control systems for automatically starting, loading and shutting down internal combustion engines has been developed by the Fulton Sylphon Division of Robertshaw-Fulton Controls Company.

Designed specifically to meet requirements of gas compressing applications, the system is expected to have wide industrial application to automated processes. It incorporates safety functions to signal or shut down the engine due to malfunction of any of an unlimited number of measurable variables. All start and stop functions are controlled in sequence and completely interlocked. Each system is engineered to the customer's particular requirements.

For more data, circle **No. E11** on Readers' Service Card, last page this issue.



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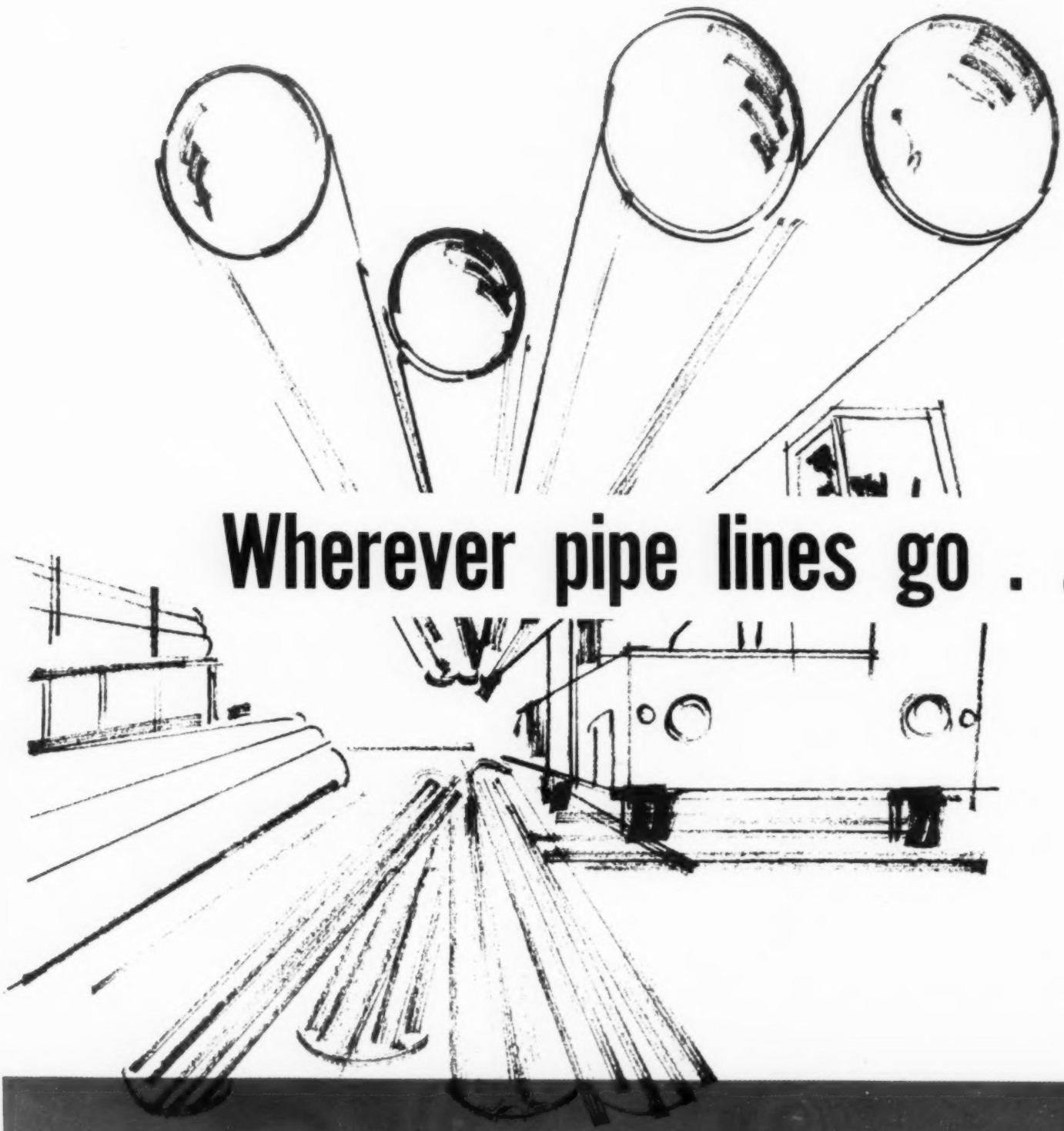

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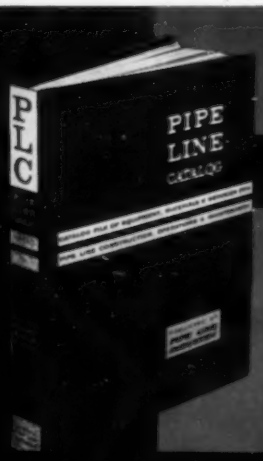

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New Equipment Literature

For more data on New Equipment or copies of Catalogs and Literature reviewed in this issue, use the Reader Service postcards just inside the back cover and facing the Advertisers' Index. Simply circle code numbers of items desired—sign and mail card.

Coating Primer

Reilly Redhead, synthetic primer in brilliant red color, is the title of a four-page bulletin released by Reilly Tar & Chemical Corporation. The primer has ability to develop high initial bond, is quick drying and designed for use in difficult drying and application conditions.

The primer is a solution of synthetic resin dissolved in a suitable organic solvent blend. It is dry to touch within 10 minutes after application, by brush or spray, to prepared clean metal surface at a rate of 500 to 800 square feet per gallon, with temperature around 70° F. It also will dry to accept enamel within two hours.

To get a copy, circle **No. E12** on Readers' Service Card, last page this issue.

Telemetering

A 52-page bulletin describing Bristol Company's Bristol Metameter Telemeters is available.

Bulletin includes principles of operation and applications of the system. It includes various types of telemeters and application to various measures and including pressure, water level, temperature, flow, motion, and position; and electrical quantities. The bulletin is illustrated with drawings and photographs.

To get a copy, circle **No. E13** on Readers' Service Card, last page this issue.

Sub-Surface Inventory

Procedures for using Barnes Layer Method to determine an exact inventory of sub-surface soils by quantity, quality and location are given in a new manual prepared by Associated Research, Inc.

The Barnes Layer Method utilizes conductance of the earth, as measured by a portable electrical instrument, Model 272M Michimho-Vibrotester, weighing only 20 pounds. Operations are not affected by extraneous noises, vibration or ground currents.

To get a copy, circle **No. E14** on Readers' Service Card, last page this issue.

Microwave Antennas

Providing detailed engineering data on 60 antennas covering all current commercial and military frequency ranges, a 16-page catalog has been published by Andrew Corporation.

Selected cables, waveguides and anti-icing devices are also offered in the 1960 Microwave Antenna Catalog.

To get a copy, circle **No. E15** on Readers' Service Card, last page this issue.

Gate Valve

A bulletin has been published by Crane Co. on its new line of gate valves, 150- and 300-pound steel flexible wedge disc valve.

The new line called Flex Gate operates easily, even if closed while hot and then permitted to cool. As body seats pinch the disc, it flexes slightly to conform to the new seating position. The valves are tight on both inlet seat and outlet seat over a wide range of pressures.

To get a copy, circle **No. E16** on Readers' Service Card, last page this issue.

Crawler Mounted Crane

A highly illustrated and descriptive bulletin on the crawler mounted Lorain Model 26 crane has been issued by The Thew Shovel Company.

Booklet gives details of machine's construction and job applications for use as shovel, crane, clamshell, dragline, and hose.

To get a copy, circle **No. E17** on Readers' Service Card, last page this issue.

Automation

A new, management-oriented publication that discusses technology, equipment, and economics of automation is available from General Electric Company.

The 16-page booklet, "Automation and You" assesses the current state of the automation art, summarizes the need for and economic benefits of automation.

To get a copy, circle **No. E18** on Readers' Service Card, last page this issue.

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SIMPLEX

flangnek standard meter tubes

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INCORPORATED

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137

For More Dependable Equipment and Service

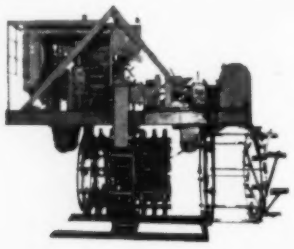
Specify

MYOCO

CLEANING and PRIMING MACHINE

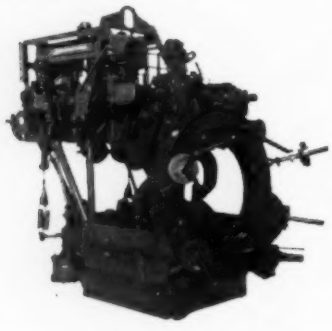
The MYOCO Cleaning and Priming Machines are available in sizes 3" thru 36". Pictured here is the 26"-32" size with two counter-rotating heads featuring the special MYOCO design counter-rotating gear box.

It is powered by an International U-9 self-starting engine and uses the Ramsey transmission. Engine exhaust is utilized to heat primer tank.



COATING and WRAPPING MACHINE

The MYOCO Coating and Wrapping Machine is powered by an International gasoline engine, with electric starter, spray type shoes, and heavy-duty transmissions and clutches. This new machine features under-pressure-crawler wheels equipped with hydraulic cylinder to maintain positive contact, easily controlled by the operator.



When you use MYOCO pipeline equipment, you quickly find that servicemen are experienced and available twenty-four hours a day with fast transportation available to serve you in any way; efficient equipment operation is assured by periodical checks; and if possible, parts and supplies are shipped the same day ordered.

MORRIS-YOUNG-OWENS CO. PIPELINE EQUIPMENT AND SUPPLIES HOUSTON, TEXAS MYOCO

MORRIS-YOUNG-OWENS CO.

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P. O. Box 35137 • Houston 35, Texas

PArkview 3-0110

In Canada: MYOCO LIMITED, Rural Route 1, Midland Ave. N., Agincourt, Ontario, Canada

Tel. AX 3-1211

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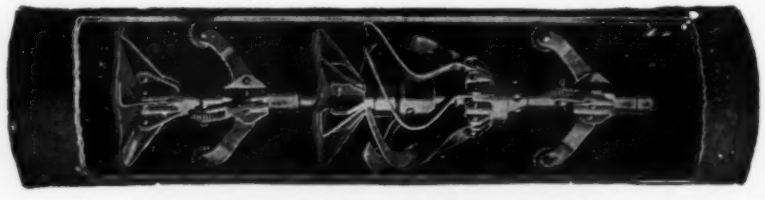

THE GO-DEVIL — READY TO GO!

Partly compressed guide arms and knives are held tight but flexible against pipe walls by pressure of individual springs. Guide arms keep scraper in line, eliminating undue driver wear and prevents cocking. Flexibility permits Go-Devil to round bends.

Go-Devil

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Unibolt—the original hinged scraper trap closure . . .

Still head and shoulders above the field!

Why are UNIBOLT Hinged Scraper Trap Closures first choice among so many pipeliners? (1) They are easier to open—only two bolts to release. No heavy lifting, nothing to fall on workmen. (2) They are the safest of all closures. The nut-lock must be released before the closure can be opened, and releasing the nut-lock automatically bleeds off any pressure that may be trapped in the line. (3) They swing open and shut on a sturdy hinge. (4) An oil-resistant rubber gasket provides a pressure-tight seal and seldom, if ever, needs replacement. Overtightening the closure bolts cannot damage the gasket.

The UNIBOLT Hinged Type Blowdown Closure for gas pipelines offers all of the unique advantages of the Scraper Trap Closure.

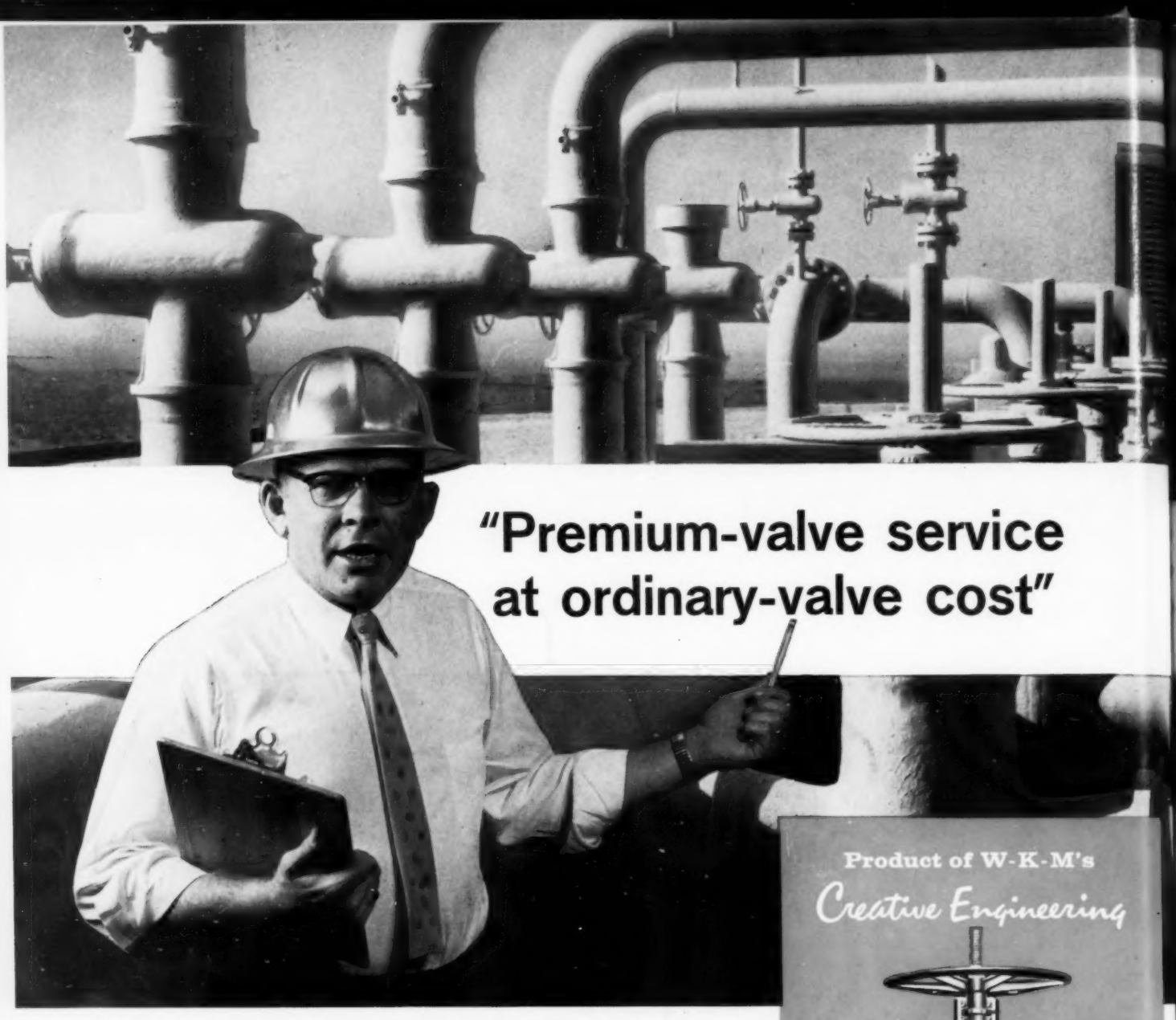
Complete details and specifications on these and other UNIBOLT products for the pipeliner are carried in Bulletin PL-590, a copy of which will be sent on request.

Unibolt Hinged Type Blowdown Closure for gas pipelines.

UNIBOLT

THORNHILL CRAVER CO.

P. O. Box 1184, Houston, Texas



"Premium-valve service at ordinary-valve cost"

W-K-M® Venturi Gate Valves

For services where you don't need a full-bore valve a W-K-M Venturi Valve gives you all the superior operating advantages of W-K-M gate valves at a cost far less than you would expect.

This is the famous W-K-M Expanding Gate Valve . . . service-proved on the world's toughest jobs. It makes a *positive* seal — metal-to-metal in addition to a Teflon initial seal. Non-lubricated operation saves maintenance. And this rugged valve is easily repaired *on the line.*

For real savings, specify W-K-M Venturis — at leading supply stores everywhere.

WRITE FOR CATALOG 300

W-K-M

DIVISION OF ACF INDUSTRIES
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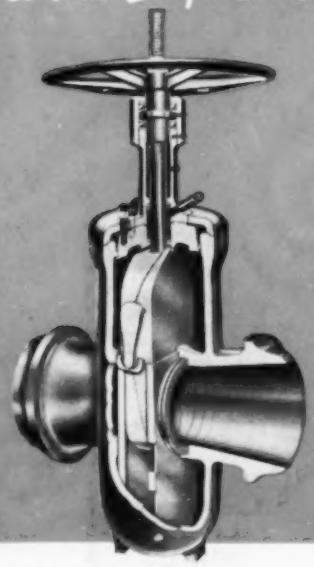
P. O. BOX 2117, HOUSTON, TEXAS

Product of W-K-M's
Creative Engineering



Cylindrical instead of rectangular opening means less pressure drop, less turbulence. W-K-M Venturis feature: ***controlled force seating,*** exclusive gate centralizing mechanism, superfinished stems, seating surfaces sealed from lading flow.

Pressure Ratings: ASA 300 through ASA 1500 lbs. Sizes 3" through 36".

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